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and

The Foundry Trades' Equipment and Supplies Association

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Contents

	PAGE
The Derby Conference	419
Introducing Those Dots	419
Difficult Copper Situation	420
Correspondence	420
Random Shots	420
Mounting Patterns on Plate and Plaster	421
Testing Foundry Sands	423
British Foundry School	425
Rapping Plates	425
A Small Oil-Fired Rotary Furnace	426
American Foundrymen's Association	430
Non-Ferrous Foundry Problems	431
American Industrialists to Study British Research Organisations	432
The International Foundry Congress in Paris	432
The Week's News in Brief	434
Trade Talk	434
Personal	434
Obituary	434
Company Reports	434
New Companies	434
Forthcoming Events	434
Raw Material Markets	436

The Derby Conference

Whilst the conferences of the Institute of British Foundrymen are arranged to conform with certain established standards, much latitude is left to the local reception committee for the organisation of the social events, as well as for the works visits. It is beyond our purview, or indeed that of any guest, to criticise the former, beyond saying that obviously everything has been done to ensure a happy time for all participants. So far as the latter is concerned, our hosts are extremely fortunate in having in their area a very large number of exceedingly well-equipped plants, and we are reasonably certain that only lack of time prevents even more foundries being included in the programme. As it is, with visits to Bamford's, Ley's, Morris's, Qualcast's and Stanton, and in addition the famous Loughborough Technical College, it can truthfully be stated that no area in Europe could show larger or more ironfounding plants within such a relatively small area. Moreover, each plant is entirely different in its organisation, lay-out and type of production. Bamford's are agricultural engineers with a large foundry attached; Ley's is the largest and probably the best equipped malleable iron foundry in Europe; Morris's are well known all over the world as manufacturers of mechanical handling equipment, with an "attached" foundry. Qualcast, though known to the general public as manufacturers of their famous lawn mowers, are, from the foundry point of view, an outstanding example of makers of repetition castings for many types of industries. The Stanton foundries rank amongst the largest in the world, and the spun-pipe section is the extremely successful realisation of years of pioneering in the Delavaud system. A comprehensive programme has been established for the entertainment of the ladies. The technical programme has been designed to be helpful to the non-ferrous founder, as the programme of works visits does not directly interest them. There is offered a selection of about half a dozen Papers, which should materially enrich the Proceedings of the Institute.

An event to which all are looking forward with anticipatory pleasure is the Edward Williams' Lecture, to be delivered by Dr. Desch on "Factors in Casting Metals." The last day, Friday, June 11, is to be spent in that most delightful of all holiday centres, Derbyshire, where the President-Elect—Mr. C. W. Bigg—and Mrs. Bigg are entertaining the visitors to tea at Matlock. For such an interesting programme we throw out the hint that the accommodation of Derby will indeed be severely taxed.

Introducing Those Dots

There are some reforms on the desirability of which most intelligent people agree, but which, perhaps for this reason, seem generation after generation to be as far off as ever. Among these we should put the reform of the calendar, the improvement of the present system of weights and measures, and the improvement of our coinage system. The fixed Easter has just as many advantages from a business point of view as the abolition of such survivals as furlongs, rods, poles and perches, chains, and pecks, which should join ells and barleycorns in obscurity, but perhaps most of all is to be gained by the decimalisation of coinage. Those who have anything to do with the education of children or the examination of young people ache to think of the time wasted in such operations as compound division and multiplication and the conversion of quantities from one unit to another. Partial simplifications have been effected. The scientist uses the metric system, and the degree Centigrade, and where he cannot he decimalises the English unit, concentrating on one only, pounds or tons, feet or miles, whichever is most convenient, and ignoring the larger and smaller units. Even here the degree Fahrenheit and the short ton exist to menace Anglo-American relations.

Lord Hirst has recently made a very strong plea for the decimalisation of our coinage. The burden of a system which, like Topsy, just growed, has been thrown off by practically every civilised industrial country. It is a handicap to education and to international trade. It is pointed out that many firms use a decimal system in their internal costing, just as they do in their measures of length, and with very great saving. We are long past the point at which Chancellors of the Exchequer, looking at decimal points, have to inquire the significance of "those damned dots." If the Government could be persuaded to act, and this is a matter which can only be carried through by the Government, it would not be impossible to decide quickly on a decimal coinage which would create the least possible disturbance to the existing system. It is a reform that has been called for by all sections of the community, traders, employers and trade unions alike, and is one that leaves us everything to gain.

Difficult Copper Situation

By "ONLOOKER."

There are a number of factors which must be taken into consideration in the straightening out of the tangle into which copper has placed itself. To apportion blame for the present difficult situation would not be easy, and in any case the discovery of a scapegoat would not make anybody a whit better off. It is easy to say that the producers ought to have abandoned curtailment sooner, or that consumers should have known better than to stampede after supplies and so give the speculators a chance to rush values up to a ridiculously high level. These events now belong to copper history, so that it is idle to repine. The next step is to see how most expeditiously normal conditions can be restored, for with a backwardation on the standard market of £5 per ton there cannot be any doubt that the situation is decidedly muddled, and at the moment copper seems to be getting worse rather than better.

It is astonishing how many transactions on the warrant market can be settled by one single 25 ton lot of copper, but there must be adequate supplies and there is obviously an irreducible minimum below which stocks cannot be allowed to fall. Lately stocks have come very near that low point, for total reserves in Metal Exchange warehouses have declined to about 15,000 tons, and although the proportion of rough copper is now once again on the upgrade, it is not very long since this stood at less than 1,000 tons. Refined brands may be delivered in satisfaction of sales of standard copper, but at the present time British stocks of refined, mainly cathodes, are being held for export, and there is every indication that before very long the tonnage of refined copper in home warehouses will have vanished. True, further supplies of refined copper are crossing the Atlantic, but it seems probable that this copper will not stay long in this country. Whatever the position may be in other parts of the world, the position in this country is that there is a real scarcity of backing for the warrant market, and what this country badly needs is an influx of rough copper which will correct the backwardation and wipe out the onerous premium ruling for the cash position.

Obviously in its present condition the London market offers no attraction for hedging operations, nor, for that matter, is there any prospect of profitable bear operations, for with such a huge premium for cash, copper must suffer a very considerable fall before any profit can accrue. As a matter of fact, it is probably bear covering which is keeping the backwardation as wide as it is, and when this is satisfied there may be some improvement. There is, of course, something of a bull account, or the tail end of one anyway, still open on Whittington Avenue, and if copper climbs a little higher (cash standard is £61 10s. at the time of writing) the bulls may be tempted to unload, in which case there would be an easing of the situation by freer offerings of much needed June metal. The sooner the change to a more normal state of affairs comes the better for everyone, because the London future market as it is operating at present is little use to anybody, except perhaps the fortunate few who are holding those early dates which are commanding such a big premium. In the meanwhile, consumers are slow to regain their lost confidence and buying is on a hand to mouth basis in spite of the fact that the market is moving up again.

Whether or not buyers will make up their minds to abandon their attitude of caution remains to be seen, but those who are talking copper higher are counting on consumers to do their bit by coming into the open. In the opinion of the writer the users of copper are in no mood to go all out in another chase after supplies, and with the knowledge that production is on the upgrade they will almost certainly decide to go slow.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

A Recruitment Problem

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Recently you have published editorials dealing with the lack of new executive blood entering the foundry industry. This you claimed was due to the lack of attraction in the industry itself, which was causing men of the type under discussion to enter other industries. From my own experience, and that of several others of my acquaintance, this is not the case.

I, myself, am indirectly connected with the Birmingham Central Technical College, and in this position meet many men trying to get on in the industry, but the biggest difficulty they find is getting into the foundry. This is an incongruous state of affairs—the foundry industry is said to require young technical men of an executive type, and we find that, although there are many such men trying to get into the industry, the latter makes it as difficult for them as possible.

For example, take a man who, say, worked a considerable time in a foundry laboratory, and has studied technical and managerial subjects such as metallurgy, mechanical and electrical engineering, costing, planning, progressing, etc., and has attained considerable knowledge of founding, including cupola and other melting practice, moulding methods from drawings, coreshop practice and so on.

This man applies for a position as an assistant foundry manager, technical assistant, etc., and nine times out of ten does not get the position. Why? Because he has not spent half his working life making simple moulds and cores and labouring generally for the firm to which he is apprenticed. During the long period he has seen far more of the sides of industry which will be of more value to him than the ability to make a mould. Other branches of the metal industry do not make it essential for a man to work as a "labourer" before he can obtain a job as an executive.

In my opinion, it is time that this apprentice bogey was removed and the argument that a man who has not spent five years moulding cannot run a foundry, is ridiculous. It is agreed that apprenticeship is of considerable advantage if it is not served at the cost of other more necessary qualifications. In the modern foundry, however, the knowledge necessary to the foundry manager is 75 per cent. general metallurgy, managerial subjects and psychology, and only, say, 25 per cent. direct moulding practice. A man adequately trained in moulding methods from drawings can more than hold his own with the man whose knowledge of moulding is confined to the certain type that he was engaged upon as an apprentice.

Yet the foundry industry still insists on this meagre and narrow practical experience at the expense of all technical and executive qualifications. Consequently men of the latter type become "fed up" with the narrowness of the foundry and find positions elsewhere. These assertions are backed up by personal experiences and contacts, and are given as the reason for the lack of the "university" type in the foundry, and not the lack of attraction of the industry for these men.—Yours, etc.,

"QUALIFIED."

Coke Slurry as a Facing for Moulds and Cores

According to L. E. Belitsky, writing in "Liteynoye Dyelo," if certain conditions are observed as to purity and chemical composition, the coke slurry obtained from the tanks in which the water employed for quenching the coke is settled, may be used as facing medium for moulds and cores.

Random Shots

The Editor puts forth a challenge in regard to a word recently used in this column, which cannot be ignored. He advises foundrymen to stick to the "good old word" "laiton," in preference to "airain" or "cuivre jaune." "Marksman" hastens to point out that it is this very word "airain" that is the good old one, and is now obsolete in modern parlance; moreover, that "cuivre jaune" is the household word, whilst "laiton" is the one favoured by technicians. He is at a loss to explain, however, how the one word fell into disuse any more than he can explain why stomach has replaced the other thing or why a biblical pig is no longer polite.

* * *

Incidentally, this matter of the right choice of words seems to be acute, judging by a leading article in the Journal. "Shot-slingers" may be a very polite and neat way of conveying the idea of a machine-that-cleans-the-surface, etc. (see leader of May 20, please), but how do Yorkshire men like it? Would they feel more at home with a word like "ferro-fettler"? The difficulty of finding words to suit new types of machines might be overcome by organising a competition, and, should the Editor follow up the idea, "Marksman" bequeaths his suggestion to anyone who cares to use it, on payment of a fee of a double Scotch and soda. It will be quite expensive treating pals to drinks in order to make sure that "Marksman" has got his fee!

* * *

The foundry industry apparently is not alone in its necessity for creating new words, and it is interesting to learn that a "phon" (Knot being a Watt) is the new British Unit of loudness, evolved in the National Physical Laboratory as a result of research on noise. Perhaps car owners can look forward to yet another gadget on the dashboard, in the form of a noise-meter. It is capable of registering both continuous and intermittent sound and this is likely to be rather awkward if the law only permits a limited number of phons per car. The wife had better sit at the back in future.

* * *

The film industry has also been busy coining words. It has been "coronating" the King! How's that for a real nasty one?

* * *

Saying of the Week.—General Smuts: "The people of Great Britain are accustomed to doing great things in a great spirit." Especially the Scotch.

* * *

"Marksman," anxious now lest he be once more pulled up, wonders whether he should have used the word "Scots" in place of Scotch, or maybe Scottish? It is all very confusing, because whereas the English quite naturally refer to Mary Queen of Scots, yet it somehow wouldn't come easily to demand a "double Scot." Even the B.B.C. announcers are not immune from confusion on this point, for one recently talked about the Scots Expressh!

* * *

London has become "milk-conscious" asserts a contemporary daily. There are at least 55 milk-bars pure and simple (could a milk-bar be anything other than pure and simple?), and upwards of a hundred more established in cafés and restaurants. No foundryman has as yet been seen in one.

* * *

Is there anyone who ever arrives at a conference quite complete in every detail? When packing for Derby, remember that, whilst you can usually borrow a white tie, or even at a pinch, a clean dress shirt, yet it is not so easily remedied if you forget to pack your dress trousers. When packing for Paris do not forget the soap. It will be needed to keep the party clean.

"MARKSMAN."

Mounting Patterns on Plate and Plaster*

By A. J. HINTON

The question of mounting patterns on plate and plaster is by no means a new one, and is of undoubted interest to all foundrymen. The essence of mounting patterns on plate or plaster is to provide a means whereby the pattern is held firmly during the ramming operation and to make the joint whilst ramming and not in a separate operation.

Many different opinions are held regarding the best method of mounting patterns on plate. Some are in favour of casting the plate and pattern as a unit whilst others prefer to mount the patterns on a machined plate after machining them to conform to the plate. Each method has its advantages and each individual pattern should be considered on its merits before deciding which method should be adopted. When plate and pattern are cast in one unit, there is an increased tendency for the joint mark to show in the finished casting, so increasing slightly the cost of dressing. On the other hand, there is no tendency for sand to be rammed between the casting and the plate, as sometimes happens in the case of a pattern mounted on a machined plate.

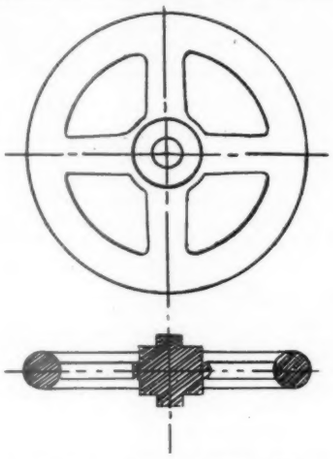


FIG. 1.—PATTERN FOR A HAND WHEEL.

The box selected for this purpose should be large enough to accommodate the plate and should be in good condition. It is of great importance that the top and bottom halves of the box fit each other as perfectly as possible. The pins and holes should be in very good condition so as to eliminate any possibility of twist. The pattern is arranged in position in the box and is then rammed up. The joint is made in the usual way only more than usual care is exercised. The top box is placed in position and rammed up. It is then lifted off and finished in the usual way, *i.e.*, ingates, etc., are cut and the top half is ready for use. It will be seen that in appearance it is just like the top half of a mould for an ordinary casting off the pattern.

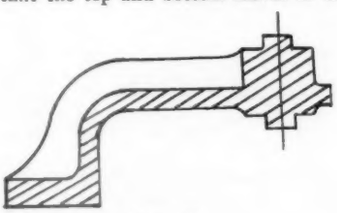


FIG. 5.

A frame, the shape and size of the required plate, is now placed in position over the pattern in the bottom box. A frame, the same size as the moulding box in use and of the same thickness as the plate required, is next placed in position and sand rammed between the two frames and strickled off level.

It should be noted that in making the joint when the pattern is rammed up it should be made in such a way as to be flat at the position of the frame for the plate. The plate frame and pattern are now withdrawn and the bottom half of the mould finished. The mould is then closed and cast in the usual way. The resultant casting will be the plate and pattern as one unit. After dressing this casting has to be carefully filed up and polished in order to make it suitable for use in the production of castings This method is suitable in all cases, whether the joint is flat or fairly complicated.

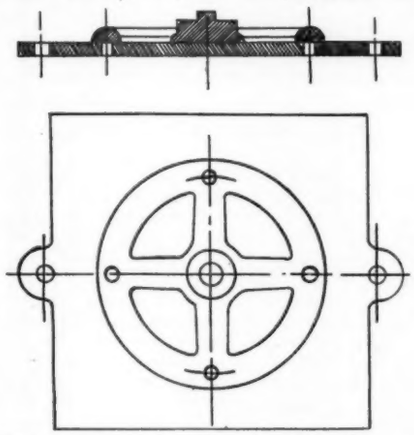


FIG. 2.—METHOD OF MOUNTING HAND WHEEL ON PLATE.

Flat-Back Patterns

In the case of patterns of the flat-back variety, they can readily be mounted on a machined plate. In this case a very much more accurate pattern can be made with consequent greater accuracy in the castings made from it. The flat-backed pattern when finished is simply screwed down in position on a machined plate and the necessary ingates added. If the pattern has a facing or facings on the back these can readily be accurately located on the reverse side of the plate after the main pattern has been mounted.

A Hand Wheel Pattern

A pattern such as that for the hand wheel illustrated in Fig. 1 can be mounted on plate as shown in Fig. 2 by making one half pattern and accurately locating it in the centre of the plate. This location should be done off the pin holes in the plate, since these will determine the position of the box used for moulding the job. In this case the same pattern is used for ramming up both top and bottom boxes. In a case of this nature the best and most reliable way of mounting the pattern is on a machined plate.

If, in the case cited above, the arms had been curved instead of straight, it would have been necessary to have mounted one half-pattern on each side of the plate. In this case two half-patterns, one for each side of the plate, are made and, after having the face located and the plate machined, are fastened together securely and screw holes are drilled. Whilst still fastened together they are filled up so that they are exactly matched on the joint. They are then separated and one half is placed in position on the plate and clamped down. The plate is then drilled, using the half pattern as a template. The other half pattern is then placed on the other side of the plate and the whole fastened together. By this means the patterns are accurately mounted on the plate and the resultant castings should exhibit no signs of twist on the joint. Various examples of mounting patterns on plate are shown in Figs. 3, 4, 5 and 6.

Plaster Patterns

In many cases it is not expedient to mount patterns on plate, and in these cases they can be mounted on plaster. One of the commonest uses of plaster is in the making of match plates or followboards. These are sometimes known as hard parts, and their function is to support the pattern during the ramming operation and to form the joint. The top part is rammed off the bottom part, and the mould completed in the usual way. The use of a single plaster match gives only part of the full benefits that may be attained by their use.

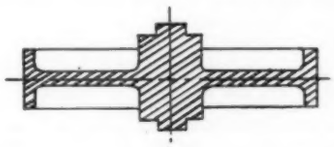


FIG. 3.

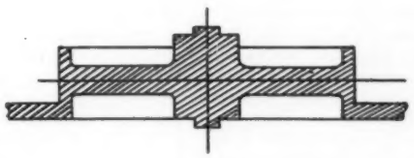


FIG. 4.

By means of a plaster match for top and bottom boxes, one attains the full benefit that can be derived from this method of mounting patterns. The matches form hard, firm surfaces on which both halves of the box may be rammed. They can, if necessary, be mounted side by side on a machine and both halves of the box made simultaneously.

Making a Plaster Match

A mould is made in the usual way, as shown in Fig. 7, but the sand is rammed a little harder and the joint made with more than usual care. The best results are obtained by using a milled red sand as a facing sand for the pattern and joint. When the top half has been rammed, it is removed and placed on its back. Any repairs to the mould are carefully made and the ingates, etc., are cut. The pattern is left in position in the bottom part, and in some cases a second pattern is carefully fitted into the top part. In each case the patterns are drilled for the

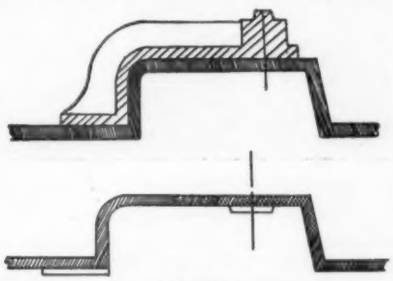


FIG. 6.

* Paper read before the Lancashire Junior Branch of the Institute of British Foundrymen.

reception of screws. When the screws have been placed in position, a second box is placed in position on the top and bottom parts, as shown in Figs. 8 and 9. The joint between the boxes is stopped with soft clay to prevent any loss of the liquid plaster, and, if necessary, reinforcing bars are introduced. The boxes are now filled with plaster of paris, which is allowed to set. When set, the plaster matches are lifted off the sand moulds and the faces are thoroughly cleaned. When the matches are completely dry, the working surface is coated with shellac. The plaster should be mixed by hand in a pail until it attains the consistency of thick cream.

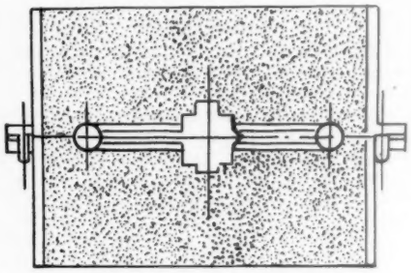


FIG. 7.—METHOD OF MAKING MOULD FOR A PLASTER MATCH.

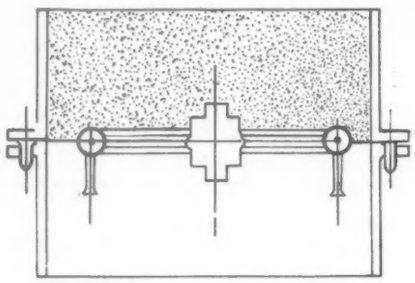


FIG. 8.—TOP PART OF BOX FOR PLASTER MATCH, WITH SCREWS IN POSITION.

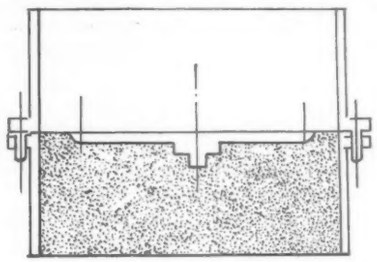


FIG. 9.—BOTTOM PART OF MOULD FOR PLASTER MATCH.

Chill Making

It is often found in foundry practice that a small chill or densener is necessary in order to obtain a satisfactory casting from a pattern. If the part to be chilled is intricate in design, much time and skill is necessary in making the pattern for the chill or densener. Again, much time can be saved by the use of plaster. A small frame conforming to the outside dimensions of the chill is made and fitted in position round the part to be chilled. The frame is then filled with plaster, and, when set, is trimmed to give the exact shape of chill or densener required. This plaster cast is then used as a pattern for making the chills.

Patch castings can be made in the same way when the necessity for such arises. Generally, the surface against which the patch fits is irregular, and if wood is used in making the pattern for the patch, much time and skill is necessary. Plaster can be used in the manner described for making these patterns, with a consequent saving of time and labour, as well as getting an exact contour of the surface to be patched.

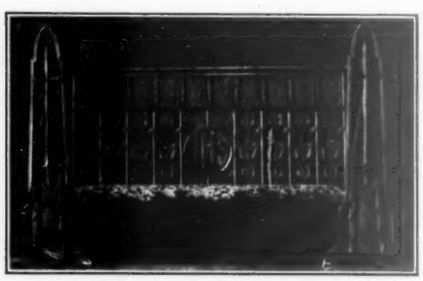


FIG. 10.—TYPICAL ORNAMENTAL CASTING MADE FROM PLASTER PATTERNS.

Ornamental Castings

Plaster is used very frequently in making ornamental castings, particularly where the same design is repeated in the same casting, as shown in Fig. 10. It would obviously be very expensive to make a complete pattern and to ensure the design being reproduced exactly. In cases such as these only one panel is made of each design by the artist. This panel is generally made in clay which is fairly easily worked. A shallow wood frame is then placed round the panel and filled with plaster. This plaster cast forms a negative of the design. The clay is removed from the face of the plaster, which is then well cleaned and oiled. This plaster is also surrounded by a frame, and this frame is filled with plaster. This plaster cast thus gives a replica of the clay design. The frame surrounding the negative is made so that the thickness of plaster in the replica is the correct thickness of the metal panel. The process of making the replica is repeated until a sufficient number of replicas have been made. These are then pared down to the correct size and mounted on a board so as to reproduce the complete design.

Any inequalities of the surface are then smoothed out and any damage repaired by means of liquid plaster. If the job has a flat back, the mounted replicas can be used as the pattern and the casting made. If, on the other hand, the back is irregular, another method has to be adopted. In this case the mounted replicas are oiled and surrounded by a frame and a second negative made in plaster. The face of this negative is well cleaned and oiled, and it is surrounded by a frame so designed as to give a positive cast of the pattern, the correct thickness and also to allow the joint being rammed off it. The positive is then cast and is made about 2 in. thick. When this is set it is turned over and cleaned. A bottom part is now rammed off it after pieces the same thickness as the casting desired have been placed in position all round the pattern and under the box edge. From this bottom part the top part is rammed and finished. The bottom part is then knocked out and a fresh one rammed up off the pattern without using the thickness pieces. This bottom is then finished and closed. The resultant casting will be the desired panel with a back following the contours of the face.

Statuary Castings

Plaster is used extensively in making statuary. A brief outline of one method used is given here. A full size model of the statue is made in clay by the sculptor and when finished is painted over with a coat of plaster tinted blue. This is followed by a thicker plaster poured into a suitable form built round the model. This wall of plaster is parted at suitable points by means of thin metal plates. The plaster mould is taken apart when set and carefully cleaned and oiled. It is then reassembled a few sections at a time. The reassembled sections are now lined with plaster in much the same way as loam is applied to a brick form. The process of reassembly and the application of plaster is continued until the entire face of the outer plaster casing is covered with plaster. The outer plaster casing is removed with a hammer and chisel. No great care is needed until the blue tint is seen. Then great care must be exercised in the removal of the outer casing. When the outer casing is entirely removed the plaster cast of the statue is given the final touch up by the sculptor and is then ready for the foundry.

Making a Rope Pulley

Frequently in foundry work it is necessary to make castings for which no pattern is available, but for which a pattern with some slight alteration could be made to do. In many cases the necessary alteration can be made quickly and cheaply by means of plaster. This method is very readily made use of in the case of circular patterns. Fig. 11 shows how this is done in the case of a rope pulley.

In the foregoing remarks plaster has been referred to continually. It should be pointed out that many proprietary materials can be used instead of plaster of paris, and also that, in general, these proprietary materials are stronger than plaster of paris.

Plaster Mixtures

Plaster of paris is a white powder possessing the property of setting in a hard mass after mixing with water. The amount of water used with a given amount of plaster of paris affects the setting time and the strength of the plaster in its final form. The consistency to which the plaster is mixed will depend upon the purpose for which it is to be used. Usually, mixtures ranging from 50 per cent. plaster and 50 per cent. water to 70 per cent. plaster and 30 per cent. water are used with good results. A 50:50 mixture requires about 30 mins. to set. In some cases it may be desirable to accelerate this time, and this can be done by the use of hot water, salt, alum or waterglass. It may also on occasion be advantageous to retard the time taken for the plaster to set, and this can be accomplished by the use of clay water, lime water, vinegar or gum arabic.

In preparing a mix of plaster of paris it is usual to calculate roughly the amount required. A quantity of water equal to the amount of plaster required is measured into a bucket and plaster added by hand until the desired thickness of plaster is obtained. All lumps must be worked out, preferably by hand, before the plaster is used. Any surplus plaster should be emptied from the bucket immediately, otherwise it will set in a hard cake in the bucket.

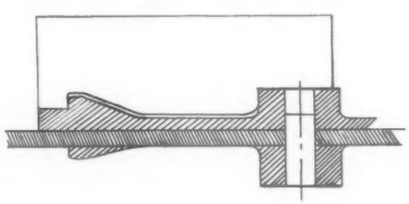


FIG. 11.—ALTERING A PULLEY WHEEL PATTERN WITH PLASTER.

CAMMELL LAIRD & COMPANY, LIMITED, of Birkenhead, have received an order from the British Tanker Company, Limited, for another tanker similar to those which they recently built for the company.

Testing Foundry Sands

EXPANSION PHENOMENA STUDIED

By W. Y. BUCHANAN

(*Concluded from page* 414.)

As references to work on the expansion of foundry sand, one should cite Dietert's Papers and the Paper[5] by Hudson which was presented to the 1936 Conference of the Institute of British Foundrymen. The author was unable to contribute much to the discussion then, but would have agreed almost wholly with Longden's contribution to the discussion[6] from practical experience and observation.

The heating of test-pieces is not representative of sand in moulds, because test-pieces are unrestricted, and therefore all observations on them should be carried out with meticulous care and as carefully applied to the foundry.

The value of practical observation should not be overlooked. There should always be a reasonable explanation for any phenomenon which should not be in conflict with practical observation. From listening to foundrymen, the author has reached the conclusion that there is a tendency to misinterpret published work, and the following should be taken as a record of an investigation on the extent to which expansion really contributes to the formation of scabs on a 33-ft. lathe bed, having a tendency to scab on the side.

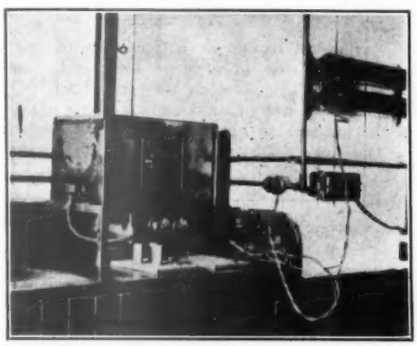


FIG. 10.—THE FURNACE USED FOR EXPANSION TESTS.

In an editorial in THE FOUNDRY TRADE JOURNAL on Hudson's last work it was pointed out that it was highly desirable to carry this line of research further, and this led the author to suppose that the following will be of interest.

Experimental Data

The furnace shown in Fig. 10 was made rather hurriedly, using an available heater element. The pyrometer was placed on the test-pieces and the expansion was measured by silica rods which touched them. The frame holding the measuring gauge was deep and very strongly built, and always remained cold since the furnace body was well insulated.

Test-Piece.—The double-compression test-piece was used, and the readings of time-temperature and expansion which were taken are recorded in Fig. 11. The overall time was always the same and the shape of the curve is clearly marked by the large number of readings, which were invariably corrected for the small amount of expansion of the silica rods. There are several distinct stages in the curve, and these have been reproduced in all the tests done. The curve was always continued to 1,100 deg. C. and took 1 hr. 15 min. to complete. Careful examination showed the centre of the test-piece to have a lag of 10 deg. C. up to 500 deg. C.; a lag of 30 deg. C. from 500 to 620 deg.; 40 deg. from 620 to 900 deg.; 30 deg. from 900 to 1,000 deg.; and no difference at 1,100 deg. C. From this and what follows it will be seen that the A.F.A. test is unsuitable for this form of testing, as the difference from the outside to the centre will tend to be very high.

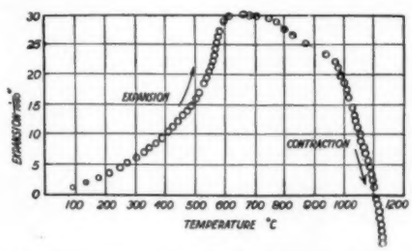


FIG. 11.—EXPANSION CURVE FOR A DOUBLE-COMPRESSION TEST-PIECE.

Variation of Density on Dry-Sand

Carrying out expansion tests on a sample of dry-sand over a large range of densities, *i.e.*, from 1.752 to 1.430, as shown in Fig. 12, made no difference to the expansion. This supports Hudson's reply to the author's previous suggestion that the variation of ramming would correct scabbing by *correcting the expansion*. However, as will be shown later, since scabbing is due to moisture and permeability and not to expansion, the variation of ramming does have a profound effect on the tendency to scab.

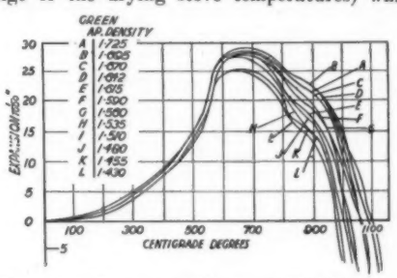


FIG. 12.—EXPANSION TESTS ON DRY-SAND OF VARYING DENSITIES.

Expansion of Green-Sand

Variation of Apparent Density.—The effect of varying the degree of ramming on green-sand facing sand was carried out over the range, 1.650 to 1.495, as shown in Fig. 13, and the effect on the expansion is seen to be negligible although it has slightly more effect than the addition of coal-dust. Comparing this green-sand series with the dry-sand series, it will be observed that the normal coal-dust addition to form green-sand is of no value in reducing expansion when considered at the same index of ramming. In the green-sand curves, the secondary hump is more pronounced but has probably little practical significance.

Rate of Heating.—Fig. 14 shows the effect of the rate of heating on a test-piece of dry-sand. The maximum expansion has been completed at 570 deg. C. by slow heating, as compared with 730 deg. in the normal rate of heating, and the temperature at which the expansion returns to zero has been reduced from 1,020 to 937 deg. C. Results in cases where the rate of heating, etc., is not specified, are not of much value.

Atmosphere

As the test-pieces were observed to give off a reducing gas it was thought that this had some effect on the sintering of the sand at very high temperatures, so two tests were made, one in pure oxygen, and the other in pure coal-gas. It will be seen from Fig. 15 that coal-gas delays the expansion up to 300 deg. (which is within the range of the drying stove temperatures) which might have some practical significance, *i.e.*, smokey or oxidising gas might be used for drying dry-sand cores. The total expansion is not altered nor is the temperature at which this occurs.

Coal-Gas.—Compression on test-piece, 30 lbs. cold; slightly cracked; test-piece fell into powder.

Oxygen.—Compression on test-piece, 200 lbs. cold; test-piece hard; colour reddish brown; small oxide holes.

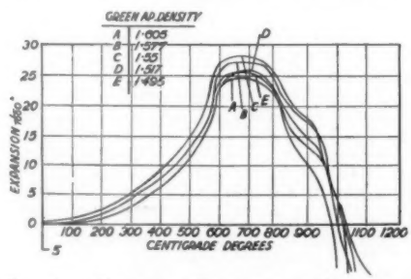


FIG. 13.—EFFECT OF RAMMING OF EXPANSION OF GREEN SAND.

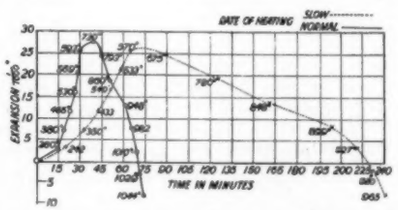


FIG. 14.—EFFECT OF RATE OF HEATING ON THE EXPANSION OF DRY-SAND.

Coal-Dust

Coal-dust was added to dry-sand in additions of from 0 to 4.75 per cent. and the expansion tests were carried out. As shown in Fig. 16, the effect on the test-pieces made to the same "index of ramming" is remarkably small; this is also shown in the green-sand and dry-sand samples (Fig. 17). Thus, whatever the function of coal-dust may be, it is not an expansion reducer.

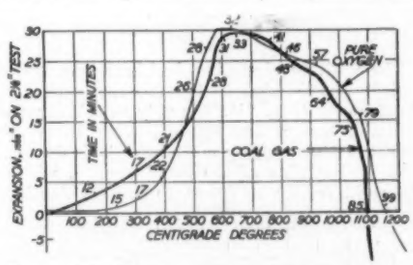


FIG. 15.—EFFECT OF OXIDISING AND REDUCING ATMOSPHERES ON EXPANSION OF SANDS.

Scabs are much more frequent in green-sand than in dry-sand, which supports the conclusion that the cause of scabs is moisture and lack of permeability rather than expansion.

The other properties of the sands made with additions of coal-dust are shown in Table III. The green-strength is increased while the per-

[5] FOUNDRY TRADE JOURNAL, June 11, 1936, p. 458, and June 25, p. 502.
[6] FOUNDRY TRADE JOURNAL, August 13, 1936, p. 123.

meability is reduced. These tests were not carried out on the same "index of ramming."

Clay, Colbond and Bentonite

In order to test the effect of clay on the expansion curve, additions were made to dry-sand which was already up to the normal strength, and although properties such as green-strength were considerably affected, for example in the case of bentonite 1.8 addition gave over 100 per cent. increase in dry-strength in both cases, as shown in Figs. 18 and 19, the effect on the expansion curve was nil when compared at the same "index of ramming." The effect of clay additions on the true density was negligible as the densities of sand and clay are the same.

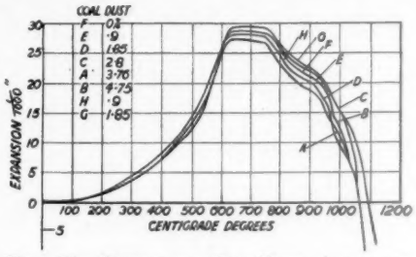


FIG. 16.—EFFECT OF COAL-DUST ADDITIONS TO TEST-PIECES WITH THE SAME "INDEX OF RAMMING."

Silt or Dust

In order to judge the effect of this extracted material on the expansion of sand, samples were taken from batches of facing sand to which successively increasing additions of dust were made and the effect of heavy additions (Fig. 20) is shown to be negligible. The same additions will be seen to have a profound effect on the other properties, and Table IV shows that the addition of 1.8 per cent. dust reduces the permeability by 17 per cent. (A.F.A. Test).

Sawdust

The addition of sawdust had been recommended and it was decided to try it experimentally in the foundry (Fig. 21). The only suitable material available was a fine sawdust from the vertical sander patternmaking machines. This dust came from yellow pine of the usual quality, which in the solid form was found to have a density of 0.40 gms. per c.c. but in the sawdust form it was found to have a bulk density of 0.17 gms. per c.c. A batch of dry-sand was made with the addition of 2½ per cent. by weight of sawdust which did not reduce the expansion as shown in Fig. 21. The dry-sand with and without sawdust was tested at the same "index of ramming." The effect of 2½ per cent. addition of sawdust was to reduce the true density of the sand from 2.68 to 2.62.

Conclusions.—The addition of 2½ per cent. by weight of sawdust = 19.2 per cent. by volume and is much heavier than could be made in general practice and has no effect whatever on expansion. Adding 7½ per cent. by weight as recommended would be equal to 57.4 per cent. by volume, *i.e.*, the casting would be made in sawdust containing 42.6 sand which is beyond reasonable practice.

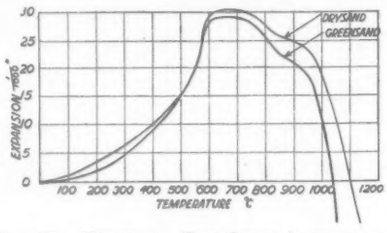


FIG. 17.—EFFECT OF COAL-DUST ADDITION ON THE EXPANSION OF GREEN- AND DRY-SAND.

TABLE III.—*Properties of Sands Related to Coal-dust Additions.*

	Coal-dust. Per cent.	Green strength, A.F.A. Lbs. per sq. in.	Perm. No., A.F.A.	Dry strength, A.F.A. Lbs. per sq. in.	Wt. of test-piece, 160 gms.	Moisture. Per cent.
F	0	3.67	96	73.3	161	7.45
E	0.9	4.35	75	71.6	161	7.54
D	1.85	4.34	70	83.6	161	7.50
C	2.8	4.58	70	79.5	161	7.43
A	3.76	4.62	67	79.5	160	7.43
B	4.75	5.60	61	72.5	160	7.3

Oil-Sand

The expansion graph (Fig. 22) for oil-sand is exactly the same as the graphs of green-sand and dry-sand up to the maximum expansion temperature, and the expansion has been completely counteracted by the contraction at about the same temperature (about 1,100 deg. C.) as in green-sand and dry-sand. The main difference is that the secondary hump, indicating an expansion, is very much more pronounced in oil-sand. This appears to be connected with the burning of the oil consituents. The oil-sand test-piece after heating was very friable as is usual with oil-sand after casting, but it was burnt pale yellow, *i.e.*, it reverted to the colour of the original sand. It should be noticed however that one never finds cores burnt to this state in castings, probably due to the lack of air in the moulds.

TABLE IV.—*Influence of Silt Additions on Moulding Sands.*

Silt added. Per cent.	H_2O. Per cent.	Permeability, A.F.A. No.	Permeability, A.F.A. Per cent. drop.	Green-strength, A.F.A. Lbs. per sq. in.	Green-strength, A.F.A. Per cent. rise.	Dry-strength A.F.A. Lbs. per sq. in.	Dry-strength A.F.A. Per cent. drop.
0	8.3	81	—	3.18	—	94	—
1.8	7.8	67	17	4.14	30	99	—
3.6	7.8	62	38	4.61	45	100	—
5.4	7.7	56	44	4.8	51	97	—
7.2	7.7	49	39	4.4	39	73	26
9.0	7.6	44	46	5.75	80	76	19
10.9	7.5	43	47	6.3	98	76	19

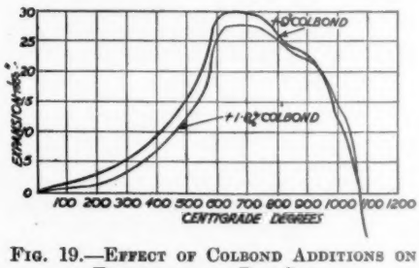


FIG. 19.—EFFECT OF COLBOND ADDITIONS ON EXPANSION OF DRY-SAND.

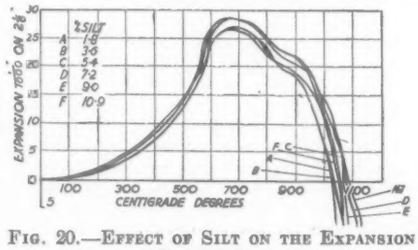


FIG. 20.—EFFECT OF SILT ON THE EXPANSION OF FACING SANDS.

Conductivity of Sands

The problem under consideration at the time when this high-temperature aspect of sand testing was receiving much attention was one of scabs on one side of a large lathe-bed casting 33 ft. long. The solution was found to be one of drying and not of expansion. Some research was carried out to obtain a clearer explanation and first of all the conductivity of dry-sand was studied. The scabs (Fig. 23) were of about 1 cm. depth, and the rate of heat transfer was measured for a furnace temperature of 1,200 deg. up to 1 cm. It might have been done at 1,300 deg. C., but the furnace would not withstand such a high temperature very long. From this set of graphs a single graph (Fig. 24) was made showing the time taken to reach 600 deg. C., *i.e.*, the maximum expansion for various thickness of sand.

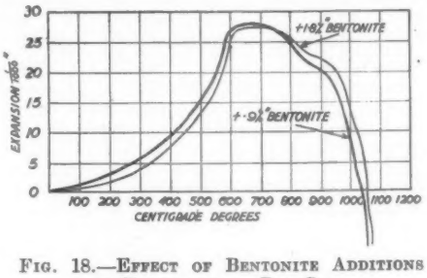


FIG. 18.—EFFECT OF BENTONITE ADDITIONS ON EXPANSION OF DRY-SAND.

TABLE V.—*Comparison between the Specific Heats of Green-sand and Dry-sand at Various Temperatures.*

Temperature. Deg. C.	Specific heat. Green-sand.	Specific heat. Dry-sand.
200	0.21	0.23
400	0.25	0.30
600	0.25	0.32
800	0.25	0.34
1,000	0.25	—
1,100	0.24	—

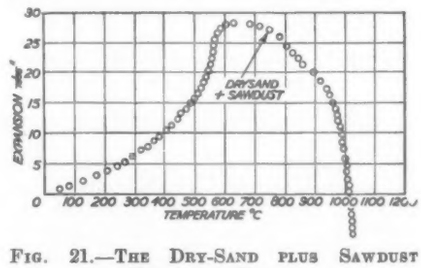


FIG. 21.—THE DRY-SAND PLUS SAWDUST EXPANSION CURVE.

The specific heat of green-sand was carried out with much duplicating over the range of temperatures shown. It will be noticed from

Table V that the green-sand has a lower specific heat than dry-sand and will therefore heat up more rapidly in the dry state. The specific heat and specific gravity of grey iron at 1,300 deg. C. were taken from the A.F.A. handbook and Fig. 25 was constructed from these data. The section of metal on which the scabs formed was ¾ in. thick or 2 cms. and this thickness of casting covers quite a large part of the foundry industry.

As the metal will solidify in both directions one can consider the case of 1 cm. of metal and

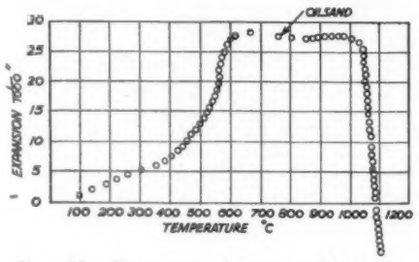


FIG. 22.—EXPANSION CURVE OF OIL-SAND.

1 cm. of sand, and that all the heat evolved by the metal assists in raising the temperature of the sand. It will be seen that the metal will have solidified before the average temperature of the 1 cm. of sand has reached the maximum expansion temperature, and if the latent heat of fusion of iron is known, the diagram can be completed for any thickness of sand and metal. The 1 cm. of sand is, of course, not uniform in temperature, and at 1 cm. deep would be much below

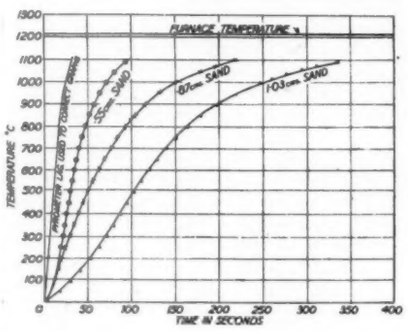


FIG. 23.—EFFECT OF RATE OF HEAT TRANSFER OF SAND ON SCABBING.

the average. It will also be seen that dry-sand is less prone to expansion than green-sand.

The practical conclusions which were reached first agree with the above, namely: (1) Expansion of silica cannot be masked by additions of other materials or ramming; (2) it is of no consequence; (3) it does not cause scabs; (4) cores and moulds are only affected for a small depth and there would be no reason to modify the sand

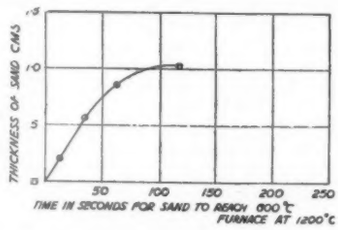


FIG. 24.—THE RESULTANT CURVE OBTAINED FROM THOSE SHOWN IN FIG. 23.

as a whole in the core, and (5) scabbing is caused by steam which would be liberated at 1 cm. deep in less than 20 secs. at full pressure, at which stage there is very little expansion other than at the surface. If expansion were the cause, the scab would not be so localised, *i.e.*, the whole face of the mould would come off. It might also be mentioned that although fritting was produced at 1,100 deg. C. in the tests, it has never been seen in the foundry where the tests were conducted.

It was intended in this Paper to include some results on compression strength at high temperatures, but this work is insufficiently advanced. However, the same line of reasoning can be taken

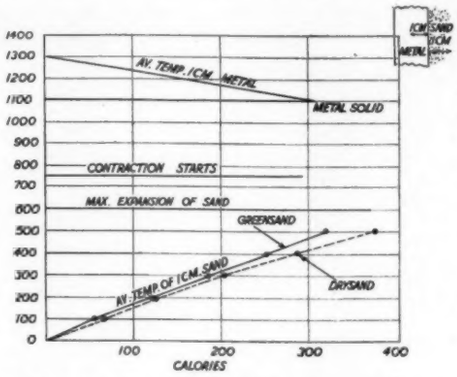


FIG. 25.—RELATIONSHIP BETWEEN THE LOSS OF HEAT OF THE METAL AND THE ABSORPTION OF HEAT BY THE SAND.

with this as with expansion. All tests on small cores were made with unrestricted expansion and no data are given as to the effect of restriction.

Sand Handling

The question of sand handling was also examined by the author, who points out that over a period of 18 months the average silt content of the sand used in his foundry was found to be 0.65 per cent., and that the dressing shop located in the foundry had a concrete floor and that everything which could be swept up there was returned to the plant and came out as facing sand.

The silt extractor could be set to vary the grain size of the dust and was certainly a valuable part of the sand treatment.

The author expresses his indebtedness to John Long & Sons, Limited, for permission to publish this Paper.

British Foundry School

The first annual report of the British Foundry School, Central Technical College, Birmingham, states that the School originated in proposals put forward to and considered by the Board of Education in 1933, when Sir Harold Hartley was President of the British Cast Iron Research Association. It was recognised that the number of students would inevitably be comparatively small, and until the industry makes a much wider demand for scientifically trained men, it was decided to limit the number of places to thirty in any one year. Thirteen students enrolled for the first session. Students have, in the main, been nominated by works in which they are employed, but applications are welcomed from students who may wish to take the course independently. The Governing Body believes that the results of the first year's working have amply justified the experiment.

(*Concluded from next column.*)

to a thin flange. The right hand half of the illustration shows wood screws which are unsatisfactory, while the left hand side illustrates the correct method. Set screws A are used to hold the plate in position in conjunction with nuts B which are recessed in the underside of flange C; a box spanner is used to tighten these nuts. After insertion and tightening the space between the edge of the recess and the nut is filled with plastic wood and allowed to stiffen. This method is far superior to the former and should be adopted wherever practicable.

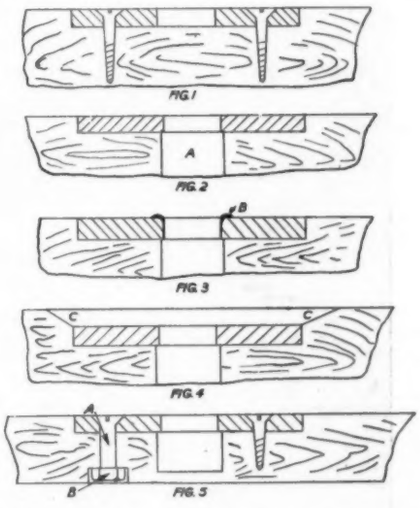
Rapping Plates

By H. R. THOMAS.

Many patterns, which otherwise are well made, suffer because no provision is made for the rapping which is necessary preparatory to removal from the mould. This defect detracts from the life of the pattern, because, despite the very smooth finish which may have been imparted to it, a certain amount of rapping or shaking must be given before it can be easily withdrawn, and unless proper provision be made, the moulder drives a bar into the most convenient place—which often is not the strongest—and proceeds to rap the pattern, frequently with disastrous results. For a one-off job this might be permissible, but for jobs where a number are required, it should be avoided.

Patterns that are fitted with rapping plates often reveal that their insertion had not occasioned very great thought on the part of the patternmaker, and after a few rappings the screws become loose and drop out. This defect is frequently encountered when patternmakers have used No. 10 screws instead of Nos. 14 or 18 to secure the plates.

Although a plate is used, the moulder will still have to insert a bar in the underlying woodwork,



which is far from ideal, if the plate has been fitted as shown in Fig. 1. This illustration shows a rapping plate of suitable sectional thickness let into the joint of a pattern. Fig. 2 shows the same plate in a similar pattern, with a hole (A) bored underneath slightly larger than the hole in the plate. This enables the moulder to insert his shaking bar in the pattern and ensure that the full force of the rapping comes on the plate and not on the woodwork, thereby affording the protection a rapping plate is required to give. Fig. 2 is not an ideal setting for a rapping plate situated on the joint of a pattern, as after but little use the edge becomes burred as shown at B, Fig. 3. This is not conducive to the correct setting of the other half pattern, which will tend to rock on the burr. A better method for rapping plates on the joint of the pattern is shown in Fig. 4, which illustrates the same plate recessed ¼ in. below the face of the pattern. The edges C of the woodwork are bevelled.

Securing a rapping plate to a thin section of a pattern is often a problem for the patternmaker. The woodwork underneath the plate being very thin, wood screws—even of large gauge—are not satisfactory, and other means have to be employed. Fig. 5 shows a plate secured

(*Concluded in previous column.*)

A Small Oil-Fired Rotary Furnace*

SOME OF ITS PRODUCTS DESCRIBED

By E. W. WYNN

It was intended to enter into detailed descriptions of the types of alloys which can be produced in this furnace, but a description of the furnace and its operation will occupy the major portion of this Paper.

Fig. 1 shows the exhaust end of the furnace and the sling on the left of the illustration is used for removing the shell when a new lining is required. The shell is placed on end in the pit, which is just visible on the left, whilst the exhaust elbow, which is mounted on wheels, may be pushed along rails, away from the furnace, this enabling the end of the furnace to be opened up for charging purposes. It was found onerous to keep the rails and elbow in very good condition, and it is almost impossible to keep the bottom of the exhaust elbow and the down-take flue level, owing to the expansion of the bricks, whilst the slag, running down the elbow, spoils the joint, unless the elbow is removed immediately the heat is turned off. This, of course, is impossible if any time is required for casting.

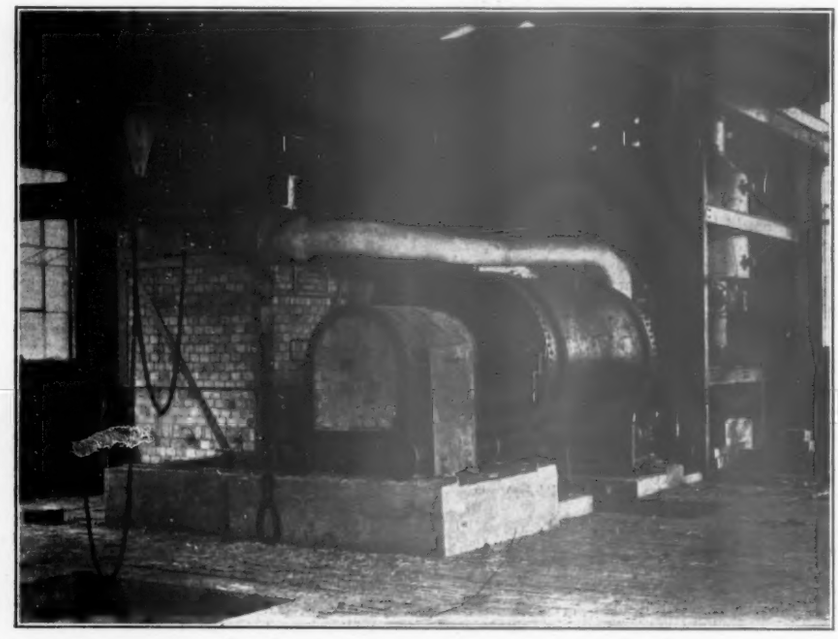


FIG. 1.—THE EXHAUST END OF THE FURNACE. THE SLING ON THE LEFT IS FOR REMOVING THE SHELL OF THE FURNACE WHEN A NEW LINING IS REQUIRED.

In order to overcome this difficulty, the elbow is lifted with the crane, which was installed for removal of the furnace shell, and when this method is used, a sand seal can be made between the bricks of the exhaust elbow and the down-take flue, and the life of both materially increased. The hinged steel sheet, resting against the elbow, is simply a cover for the down-take flue, when the elbow is removed. These furnaces are designed to melt up to 3 tons per heat, but the one used by the Audley Engineering Company is designed to melt 30 cwts., and when the lining is worn it usually melts 35 cwts. to 2 tons, which is more economical.

The furnace consists essentially of a welded steel cylinder with a cone bolted to the cylinder at each end. Lead washers are used to allow for lining expansion. The teeming spout is separate from the furnace shell, and held in position by four lugs welded to the steel cylinder. The whole shell is perforated with ½-in. holes, on approximately 12 in. centres, to allow the escape of moisture from the green lining.

The furnace revolves at approximately 1¼ revs. per min., on steel tyres bolted to the body. The drive is effected by friction rollers through a gear box driven by a 2-h.p. motor. The motor is controlled by push buttons, which are so placed as to allow the operator a full view of the spout when pouring the metal from the furnace. This control allows rotation in clockwise and anti-clockwise direction, and inching in both directions.

The burner is of special design, and works with an air pressure of 0.86 ozs., while the oil is fed by gravity from a tank placed about 10 ft. above the horizontal centre line of the furnace. The burner is composed of a tube, on one end of which is welded a disc which seals the air elbow, and the other side is recessed to form an oil-tight joint with the movable oil supply pipe. On the other end is fitted an impeller which contains the oil jets. This impeller is loose on the tube, and during firing is rotated by the air supply. Air is controlled by a simple butterfly valve, and is directed past the impeller by a small cylinder, which fits inside vanes cast integral with the elbow, and secured by a set screw at the side. The remainder of the air passes outside this cylinder and is given a rotary motion by the special shape of the vanes previously mentioned. The outside stream of air, and inside stream of atomised oil and air are thus intimately mixed and ignited just inside the body of the furnace. The length and shape of the flame is largely controlled by the length and position of this small cylinder. The original elbow was adversely affected by heat and furnace gases, so it was decided to replace the original one by one cast in an austenitic alloy (the patent rights of which are held by the Audley Engineering Company). This elbow seems to be giving much more satisfactory service. A seal between elbow and shell is made with a series of stepped rings. Here again the austenitic rings give better service than those originally incorporated.

Correct setting of the elbow (which is adjustable) and stepped rings is very important in order to prevent furnace gases and flame escaping outside the furnace, and yet allow the furnace to rotate. The oil supply is controlled by an ordinary ball seated valve in the supply pipe. Either Shell or B.P. 200 secs. oil is used, and electric immersion heaters are placed in the oil line to facilitate starting up. Careful control of air and oil is essential for the economy of metal, minimisation of metal losses and ensuring a high quality of product. The best indication of correct flame control is obtained by careful observance of the colour and shape of the flame issuing from the exhaust end. A dark smokey flame obviously indicates excessive oil. If the flame is thin and reduces in diameter from the furnace to the elbow, furnace conditions are oxidising; if parallel, neutral, or if slightly expanding, reducing.

Fig. 2 shows the operator putting the burner into position in the burner elbow. The impeller previously referred to can be seen, as well as the electric immersion heater in the oil supply pipe, oil control valve, and swivel elbow which is clamped against the burner elbow by means of the yoke and screw, which can be clearly seen attached to the burner elbow. The push-button control can also be seen in the left hand corner.

Fig. 3 shows all the furnace controls, such as the indicator pyrometer, the oil control valve, the exhaust and recuperator dampers, etc. Heated air is supplied by passing through a recuperator under pressure from a fan, which is driven on the 30 cwt. capacity furnace by a 7.5 h.p. motor. In order to prevent over heating of the tube, the air temperature is controlled by manipulation of dampers in the recuperator. A pyrometer tube is also placed in the hot air supply pipe near the burner elbow, and these form the basis of the furnace control. The hot gases from the furnace are taken into the recuperator by means of a bricked elbow. There is a gap between the exhaust elbow and the furnace, which draws in cold air with the flame, and prevents overheating of the recuperator, etc., but allows complete combustion to take place in the elbow when the furnace is operated improperly.

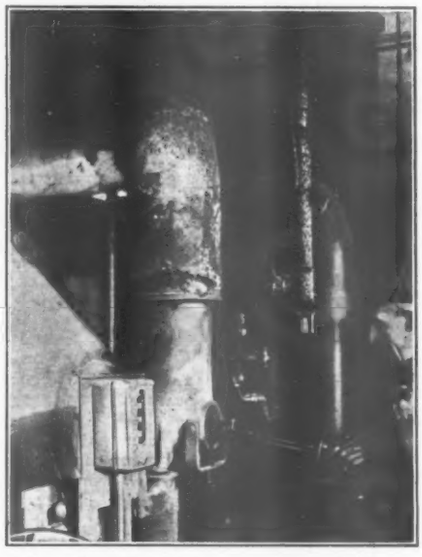


FIG. 2.—THE BURNER BEING INSERTED INTO THE BURNER ELBOW.

Fig. 4 shows the inside of the recuperator, which consists of four double U pipes with a dividing wall between each four sets of U bends. The tubes are suspended from the top of the

* A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. J. Hogg presiding.

recuperator, and are therefore allowed easy movement during heating and cooling which reduces distortion to a minimum. Waste gases pass outside the tubes, which are heated by radiation from the containing walls, and not by direct contact with the waste gases, and are thus partially insulated by a stagnant layer which remains round the tubes. This accounts for the long life obtained from the mild steel tubes, and malleable elbows of which the recuperator is built. The original recuperator tubes last approximately two years, but they would have an even longer life if the elbows were more securely fixed to the tubes, and if they were moulded in such a way that the metal thickness was even, or, in other words, if the core had not been allowed to float.

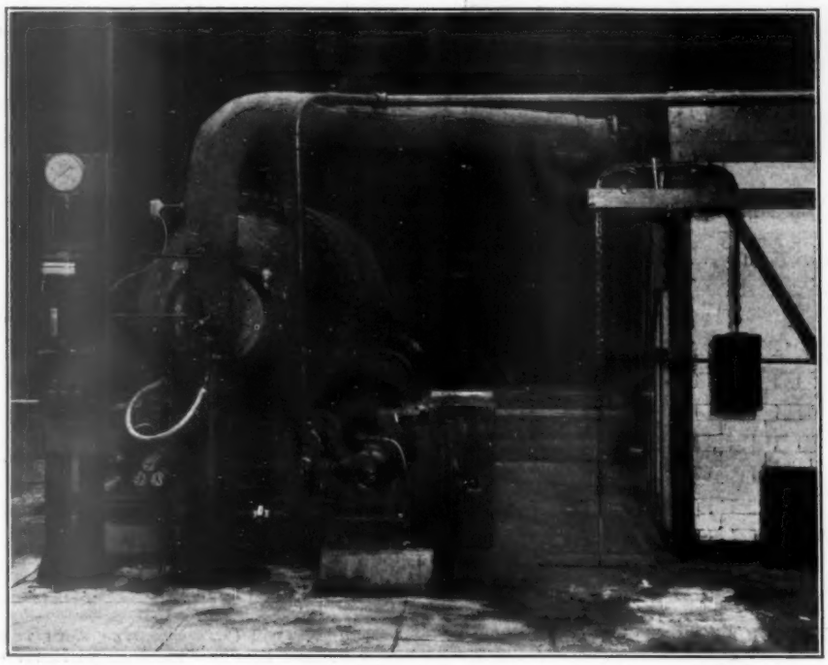


FIG. 3.—THE FURNACE CONTROLS.

Fig. 6 shows the exhaust elbow removed for charging. The furnace is charged after the elbow has been removed and the door of the furnace opened. Mechanical charges can be used, but in most foundries the charge is thrown in by two or more men, and when the furnace is full the sheet-iron cover is lowered over the entrance to the exhaust flue. The furnace lining is rammed into position around formers and, in order to facilitate lining, the shell is placed on end in a pit. The composition of the lining is approximately 96 per cent. silica, bonded with alumina. There are various brands of siliceous linings marketed, but all require great care in ramming and initial firing. The most frequent cause of early breakdown is due to spalling before a smooth glazed surface is formed. In order to avoid this trouble the material must be evenly rammed, properly vented and dried before actual glazing. The general method is to place a bucket fire under the rammed shell for approximately six days. Once drying is commenced the temperature of the lining should be gradually increased to about 250 deg. C., then placed on the friction rollers, and a wood or charcoal fire kept going for three to four hours. The furnace should be turned through 90 deg. every few minutes to avoid local overheating. At this stage it is advisable to slack off the end bolts about a turn to allow for the expansion of the material. About 5 to 6 cwts. of cupola slag is then thrown in, and the furnace lit up. The flame should be as soft as possible until the furnace is at bright red heat, when full heat should be applied, and the furnace rotated for about 40 minutes, after which the slag is run out and the lining ready for use. Rapid changes in temperature should be avoided as far as possible throughout the life of the lining, which is largely within the control of the user (provided it is in the first place suitable for the type of metal being melted).

TABLE I.—*Melting Cost per ton.*

Oil (at 5d. per gall.), starting from cold (32 galls.), 13s. 4d.
Oil starting hot (27 galls.), 11s. 3d.
Oil for first malleable heat (39 galls.), 16s. 3d.
Oil for grey iron heat (18 galls.), 7s. 6d.
Oil for second malleable heat (25 galls.), 10s. 5d.
Cost of labour and control for charging (15 hrs.), 15s. (approx. 2s. 1½d. per ton).
Cost of lining (150 heats, or 32 cwts.), approx. 2s. 1d. per ton.
Direct cost of melting, 17s. 6d. per ton.

It is difficult to make definite statements regarding the actual numbers of heats obtained. The furnace under review usually obtains 120 to 180 heats, and about 60 after patching. In fact, the shell has not been completely lined for twelve months. The shell now in use has had the burner-end patched three times, and it appears to be possible to patch it many more times. Lining loss occurs between the burner end and the tap hole, whilst the other end retains almost its original diameter.

Fig. 7 shows the cone removed from the burner end, and the shell stripped to the tapping hole. It is then placed on end (exhaust end down), and formers are placed in position and rammed up level with the bolt flange. The precautions taken in ramming a new lining are, of course, observed in ramming the patch.

Fig. 8 shows the cone rammed up and stretched level. It is then turned over and placed on the patched cylindrical shell of the furnace, and bolted up. New lead washers are placed between nut and shell to allow for expansion, and the whole is glazed as previously mentioned. A ring of bricks is usually required in the charging end of the shell before firing. It is estimated that the cost of lining is about ¼d. per ton of metal melted, whilst the oil consumption has been determined accurately by ascertain-

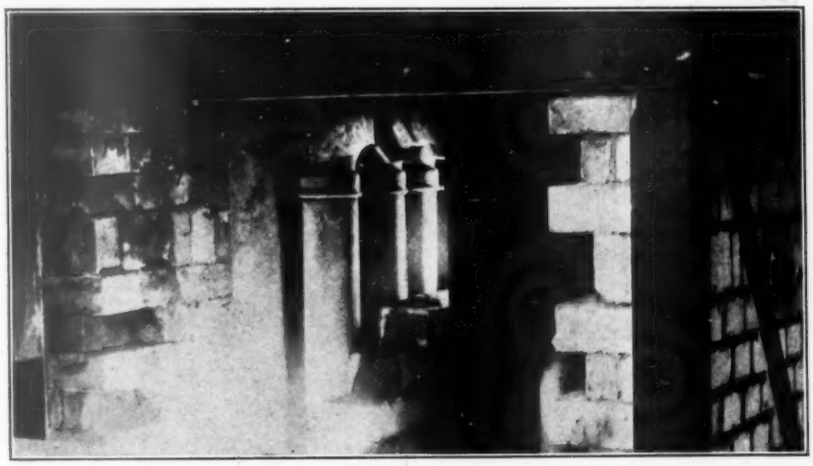


FIG. 4.—INTERIOR OF THE RECUPERATOR CONSISTING OF FOUR U PIPES WITH A DIVIDING WALL BETWEEN EACH.

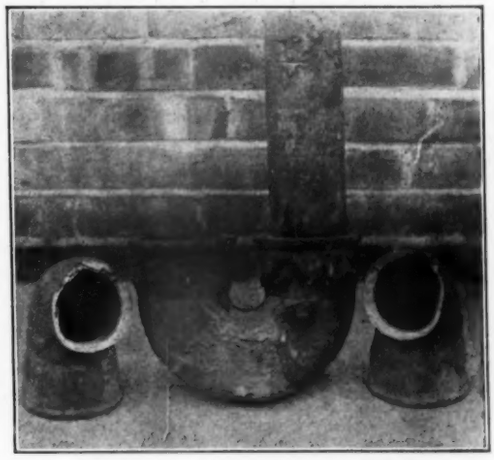


FIG. 5.—THE U PIPES AFTER TWO YEARS' SERVICE.

The actual elbows and tubes after two years' service are shown in Fig. 5. The mild steel tube is obviously in good condition, but was taken out due to failure of the screwed joint. The replace tubes were drilled through the screwed portion, and a half-inch steel peg driven through to prevent failure at this point.

ing the depth of oil in the supply tank, and is fairly constant at 27 galls. per hr. under normal working conditions.

Fig. 9 shows a record of a day's run taken on the actual pyrometer recorder by which the furnace is controlled, and shows actual melting, charging, casting, and preheating times. Costs, shown in Table I, have been taken from this record, and the figures can be checked against the heating and cooling curves shown.

Table I excludes overheads, power, depreciation, etc., which are too variable to be of interest here. No attempt has been made to compare the costs of melting in a rotary furnace against a cupola, because the rotary furnace will melt alloys which are very difficult or impossible to produce in the cupola, but a personal opinion is that there are still many advantages to be gained by using the cupola when making grey iron castings. It is also personal experience that cheaper material, that is, steel, can be used more extensively in the cupola than in the rotary furnace, but again comparison should not be made. In the cupola a 50 per cent. steel charge will give iron containing 3 per cent. carbon, but, of course, if a 50 per cent. steel charge was melted in the rotary furnace the carbon would probably be 1.7 per cent., and therefore no longer cast iron. Percentages of Si, Mn and C can definitely be controlled within very small limits, but some experience of the furnace is required before this exact control is possible. Losses in Si and Mn up to 40 per cent. and carbon reaching 20 per cent. have been known, but with some experience these elements may be controlled within the limits of the raw material used. Silicon control is better if sand or some other siliceous material is added with the limestone, and carbon is also more closely controlled by adding coke-dust simultaneously. This precaution can, of course, be used when making malleable or any other low carbon alloys. The rotary furnace is very suitable for making black-heart malleable iron, owing to the fact that the sulphur can be kept as low as the material used, and low carbon metal may be melted with ease. As special irons are not required, the raw material is relatively cheap. Metal temperatures over 1,500 deg. C. are obtainable which give fluid metal with carbon down to 2 per cent. This accurate control of metal enables economy to be effected during the annealing of black-heart malleable, and reduces the quantity of rejected castings, whatever type of alloy is being melted.

Fig. 10 shows some spanners which were annealed in 48 hrs.,—the actual cycle being:—10 hrs. up to 900 deg. C.; 10 hrs. at 900 deg.; 9 hrs. cooling to 720 deg.; 6 hrs. at 690 deg., and cooling to 500 deg. C. in 12 hrs. It is not suggested that this is a very scientific test although it is a very effective selling test to the

FIG. 6.—THE FURNACE WITH EXHAUST ELBOW REMOVED FOR CHARGING.

FIG. 7.—THE CONE REMOVED FROM THE BURNER END AND THE SHELL STRIPPED TO THE TAPPING HOLE.

TABLE II.—*Data on Spanner Test-Bars.*

Bar No.	Max. strength Tons per sq. in.	Elong. Per cent. on 2 in.
1	28.1	7.5
1	26.8	8.0
2	22.4	7.0
3	25.4	6.5

Analysis.—T.C, 2.36; Si, 1.00, and Mn, 0.38 per cent.

Heat-treatment.—8 hrs. to 850 deg. C.; 4 hrs. at 850 deg.; 12 hrs. to 720 deg., and 12 hrs. to 650 deg. C.

FIG. 8.—THE RAMMED-UP CONE STRETCHED LEVEL.

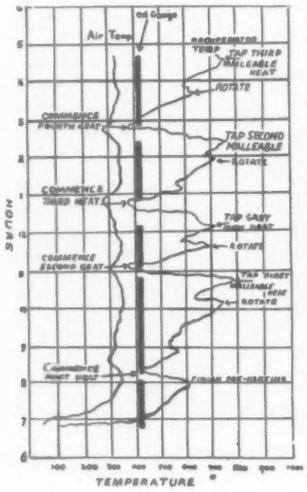


FIG. 9.—A TYPICAL DAY'S RUN.

FIG. 10.—SPANNERS ANNEALED FOR 48 HRS.

unscientific, and serves in this case to illustrate the malleability of material annealed to the above cycle. The approximate analysis and actual results obtained on test-bars cast and annealed with the spanners are set out in Table II.

These test figures are above the B.S.I. specification, but generally the elongation is slightly lower, and the tensile higher than that obtained from malleable using a longer cycle, but the yield point of the short cycle material is definitely over 60 per cent. of the ultimate tensile, which in the author's opinion reduces the value of any material used in engineering.

Fig. 11 shows a micro-section revealing an all-ferritic ground mass structure of this short annealed malleable and Fig. 12 shows a section of malleable iron which is mainly pearlitic and was annealed for 24 hrs. The latter type of material has many applications due to its high yield point, and a tensile strength of about 30 tons per sq. in. associated with an elongation ranging from 2 to 4 per cent. The silicon is generally higher than in the iron shown in Fig. 11, but the carbon is lower. The annealing cycle is shorter due to the fact that the furnace can be cooled very much quicker through the Ar_1 range. Definite control of material, casting temperature, etc., is essential if any success in the production of this material is to be obtained, and its analysis must be based on the cross-sectional area of the casting to be made, otherwise it will contain primary graphite, which, of course, results in weak porous castings with little malleability. High-strength grey iron can be produced with regularity, and tensile strengths of 18 tons per sq. in. can be considered as normal.

The specimen for the photomicrographs (Figs. 13 and 14) was taken from the centre of a heavy section of a grey iron casting, and shows regularity of graphite, size and structure. Its high strength, however, is usually obtained by reducing the total-carbon content, which, of course, increases foundry problems, and moulding and fettling costs. Thus although when properly made, a very sound casting is obtained with a structure which gives a regular Brinell hardness throughout, it will very often fail in service due to brittleness. These results can be obtained by alloy additions to cupola metal, but this method is more expensive.

A photomicrograph of an iron of the Emmel type containing 2.5 per cent. Si and 2.5 per cent. C, which was melted in the rotary furnace and which had a tensile strength of about 18 tons per sq. in. is shown in Fig. 15. This iron is easily made in the rotary furnace, and has many applications, such as for housings, slides, tables, bases, etc., and for the machine-tool industry. It machines easily having a steel-like finish; has good wear-resisting properties; an even hardness of about 210 Brinell can be

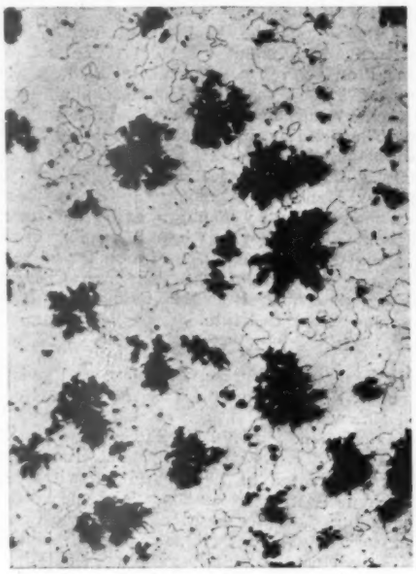


FIG. 11.—SHORT-CYCLE ANNEALED MALLEABLE IRON, SHOWING GROUND MASS OF FERRITE. ETCHED. × 90.

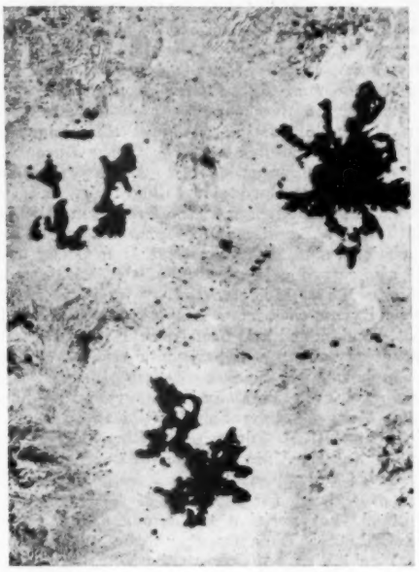


FIG. 12.—SECTION OF MALLEABLE IRON AFTER ANNEALING FOR 24 HRS ETCHED. × 90.

FIG. 13.—SECTION FROM A HEAVY HIGH-STRENGTH GREY IRON CASTING. UNETCHED. × 60.

FIG. 14.—THE SAME IRON AS SHOWN IN FIG. 13. ETCHED. × 400.

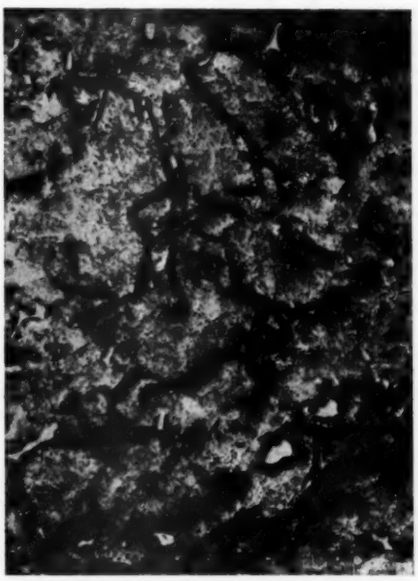


FIG. 15.—EMMEL TYPE IRON CONTAINING 2.5 PER CENT. SILICON. ETCHED. × 150.

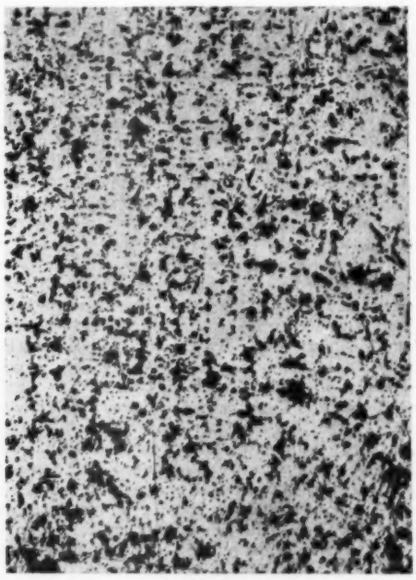


FIG. 16.—ACID-RESISTING, 15 PER CENT. SILICON IRON. UNETCHED. × 60.

obtained without using chills, and it can be made free from hard edges, but here again foundry costs and brittleness are increased.

High-quality acid-resisting 15 per cent. silicon iron is easily produced in this type of furnace, and Fig. 16 shows a photomicrograph of such an iron, which contains pure silicide with fine graphite. The main trouble with this material when produced in the cupola is the presence of large graphite which segregates at all heavy sections and corners, making an already brittle material even more fragile. The quality of the material shown in the photomicrograph would, it is presumed, be produced in any melting unit where it was not melted in contact with carbon, but it is doubtful if any melting unit, where this was possible, would melt as cheaply as the rotary furnace. The reason for melting out of contact with carbon, is because the liquid solubility of a high-silicon iron for carbon, increases with increasing temperature,

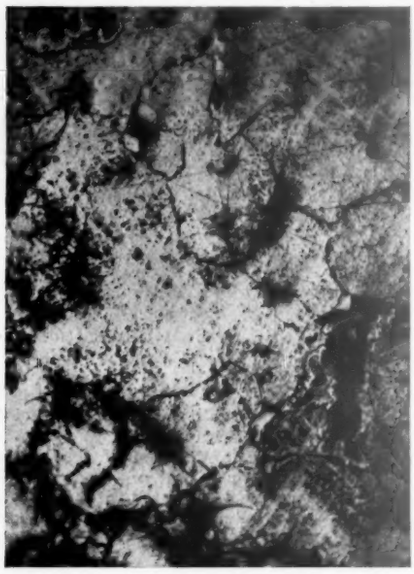


FIG. 17.—AUSTENITIC ALLOY FOR CORROSIVE SERVICE. × 400.

and therefore as the temperature decreases the excess of carbon quickly separates out in large flakes. It is obviously desirable that the percentage of carbon in the molten alloy should be less than the alloy will hold in solution when it is 20 deg. C. above its melting point. Some experience is necessary before this alloy can be successfully made in the furnace. The method is to melt a solid charge made up of 10 per cent. silicon pig and 90 per cent. steel. When this is molten sufficient 50 per cent. low carbon ferro-silicon is added to bring the silicon up to between 14 and 15 per cent. By this method the carbon can be kept well under 1 per cent. The foundry difficulties associated with this metal are appreciated by most foundrymen and need no elaboration.

Fig. 17 is a photomicrograph of Audcoloy, which is an austenitic alloy used for corrosive services. This material is much more sound and consistent in structure when produced in the rotary furnace, as against pot-melting due to the more thorough mixing of the metals and higher melting temperature so easily obtained, whilst the reduced cost as against pot-melting or cupola melting is obvious. Other types of austenitic iron can be produced quite as well and as cheaply as Audcoloy. Personal opinion of this melting unit is that it is useful for producing special types of iron cheaply and is easily controlled and cheap to run. Its main advantage is that the charge is economically melted out

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American Foundrymen's Association

NEW OFFICERS ELECTED

Mr. Hyman Bornstein, director, testing and research laboratories, Deere & Company, Moline, Ill., was elected President of the American Foundrymen's Association at the annual business meeting on May 6. Mr. Bornstein has served at various times as chairman of the A.F.A.'s committee on Grey Iron Castings; as a member of the committees on Specifications for Malleable Castings; Liquid Shrinkage Investigation of Metals Advisory to the Bureau of Standards; Ferrous Metals Advisory to the Bureau of Standards; Metallography, and has been general chairman of the Grey Iron Division of the A.F.A. and many others. At present he is chairman of the Alloy Cast Iron Committee. He also served as a director of the A.F.A. from 1932 to 1935. Mr. Bornstein, who is a leading authority on cast iron, was born in Chicago in 1891, and attended the Armour Institute of Technology, from which he was graduated with a Bachelor of Science degree in Chemical Engineering in 1911, and was graduated from John Marshall Law School, Chicago, in 1915 with an LL.B. degree. After serving as chemist for the Union Pacific Railroad and later for Swift & Company, Chicago, he held the position of chemist for the City of Chicago. He resigned that position to become a captain in the Ordnance Department at the outbreak of the World War. Following the War, he became associated with Deere & Company.

In addition to his A.F.A. activities, Mr. Bornstein is a member of the American Chemical Society, American Institute of Mining and Metallurgical Engineers, American Society for Testing Materials, and American Society for Metals. He has served as chairman of the Quad City Foundrymen's Association, now the Quad City Chapter of A.F.A., of which he is a director, as chairman of the Tri-City Chapter of the A.S.M., and as chairman of the Tri-City Technical Council.

Mr. MARSHALL POST

Mr. Marshall Post, who was elected Vice-President, was born in San Antonio, Texas, and began his career in the foundry industry as an apprentice moulder with the American Steel Foundries, Granite City, Ill. Later he worked his way up to the position of foundry superintendent of this concern. Since 1925, Mr. Post has been Vice-President and works manager, Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa.

Mr. H. B. HANLEY

Mr. H. B. Hanley, who was elected a director of the Association, began his industrial career with Saunders & Franklin, Providence, R.I. Later he was connected in various capacities with the New London Ship & Engine Company, Groton, Conn.; Holland Submarine Torpedo Boat Company; Electric Boat Company; and General Ordnance Company. During this period, Mr. Hanley helped to build and operate the first foundry plant in the United States for the exclusive manufacture of submarine Diesel engines and installed and operated the first electric furnace in the New England area for the manufacture of iron and steel castings to U.S. Navy specifications. During the period 1923 to 1929 he became associated with Whitehead Bros. Company, New York, as manager of its testing department and as consultant on foundry sand practice. Mr. Hanley has written numerous Papers on sand control, and in 1923 he contributed to the annual A.F.A. exchange Paper to the International Foundry Congress in Paris on "The Bonding Substance of Moulding Sands; Its Composition, Properties and Tests." Since 1929 he has been connected with the American Laundry Machinery Company and recently has been made foundry manager and chief metallurgist. Mr. Hanley has been a member of the American Foundrymen's Association for 23 years and is a member of the American Chemical Society, National Research Council, and the Iron and Steel Institute.

Mr. D. P. FORBES

Mr. Duncan P. Forbes, President and general manager, Gunite Foundries Corporation, Rockford Ill., who has also been elected a director of the Association, received his higher education at Yale University, New Haven, Conn., from which he was graduated in 1919. The following year he took post-graduate work at Yale, specialising in metallurgy. Later he spent some time in the laboratory of Prof. Enrique Touceda, Albany, N.Y., studying the metallurgy of malleable iron. In 1928 the Gunite Corporation was organised and Mr. Forbes was made President. Later he was elected to the presidency of the Rockford-North-western Malleable Corporation, which became the Gunite Foundries Corporation in 1932.

Mr. THOMAS KAVENY

Mr. Thomas Kaveny, President, Herman Pneumatic Machine Company, Pittsburgh, Pa., has also been elected a director of the Association. He was born in Canaudaigua, N.Y., and was sales manager of the N. K. Fairbank Company, Chicago, Ill., for 17 years. He resigned that position to affiliate with the Herman Pneumatic Machine Company.

Mr. C. J. P. HOEHN

Mr. C. J. P. Hoehn, President, Enterprise Foundry Company, San Francisco, Calif., has also been elected a director of the Association. Mr. Hoehn, who was born in San Francisco, began his career in the foundry industry in 1890 as an apprentice moulder with the company, of which he is now President. He is now Vice-Chairman of the Northern California Chapter of A.F.A.

Mr. C. E. SIMS

Mr. Clarence E. Sims, supervising metallurgist, Battelle Memorial Institute, Columbus, Ohio, who has also been elected a director of the Association, was born in Chicago. Mr. Sims attended the University of Illinois, from which he was graduated with a Bachelor of Science degree in Chemical Engineering. He continued his studies at the University of Utah, and received his Master of Science degree the following year. He then entered industry, and served in various capacities with the numerous companies, and early this year he took his present position with the Battelle Memorial Institute.

Awards

The Association on the recommendation of its Board of Awards, has presented three medals in recognition of achievement and distinguished service to the foundry industry. The John A. Penton gold medal has been awarded to Mr. J. W. Bolton, Lunkenheimer Company, Cincinnati, in recognition of his work in metallurgy

(*Concluded on page* 432.)

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of contact with carbon, and therefore enables more accurate chemical control and what is more important accurate control of grain and graphite size. The fact that small batches of metal can be melted is also an advantage to a small foundry having to make castings in very different ferrous alloys.

The author is especially desirous to thank the directors of the Audley Engineering Company, Limited, for permission to publish this Paper; Stein & Atkinson, Limited, for the loan of some of the illustrations, and those members of the staff of the Audley Engineering Company, who in any way have helped towards the production of this Paper.

Non-Ferrous Foundry Problems*

By R. J. KEELEY

Among the many problems confronting foundrymen, the selection of the proper alloy for a specific use is of vital importance. For example, in a foundry engaged in the production of pump bodies of acid-resisting metal, having a composition of 75 per cent. copper, 15 per cent. lead, and 10 per cent. tin, a complaint was received from one of their customers who had purchased a pump that failed after being in service only a few months. This copper-lead-tin alloy was developed primarily to meet the demands for a metal to resist the corrosive action of mine water containing a small percentage of sulphuric acid. This particular pump was in service in Bermuda, and it was necessary to handle the problem by correspondence. In the subsequent investigation, the defective pump parts were subjected to chemical tests and the corroded surfaces were found to contain approximately 3 per cent. less lead than existed in the original castings.

An analysis was then made of the pump water, which revealed that it was in reality sea water and contained a large percentage of soluble chlorides. It was quite clear that this was responsible for the failure of the pump, as metal of such composition was not intended to operate in salt water. This is because of the strong affinity that chlorine has for lead.

The pump was replaced with a copper-tin bronze, having a composition of 88 per cent. copper, 10 per cent. tin and 2 per cent. zinc, and after many months had elapsed the pump was still operating satisfactorily. Had the nature of the water been known, the leaded bronze would not have been used, and the failure of the pump would have been averted. In this instance, the selection of the proper alloy was not made, due to the fact that the true operating conditions were not known.

Defective Meter Bodies

Another somewhat similar example was encountered in a foundry engaged in the production of meter bodies and parts, with an alloy consisting of 85 per cent. copper, 5 per cent. lead, 5 per cent. tin and 5 per cent. zinc. This company received several complaints due to failure of the meters in service. Investigation showed these failures to be due to a white deposit forming on the inside of the meters, this deposit accumulating to such a thickness that the meters would not record properly and had to be removed from service and replaced.

Since the meters that failed were in service at far distant points, it was first thought that the composition of the water in these localities was directly responsible. However, a series of experiments was outlined, which it was hoped would throw some light on the subject. Several rough castings were selected for test and were filled with ordinary mains water and allowed to stand. A white deposit formed almost immediately. This test was then repeated with chemically pure water with the same result. A sample of this white deposit was collected and analysed, and it was found to be carbonate of lead. This deposit, therefore, could only be formed by the carbon dioxide in the atmosphere being absorbed by the water and reacting with the lead to form lead carbonate.

Subsequent tests were made to determine to what extent the lead content should be decreased to prevent the formation of the lead carbonate deposit. After numerous tests with alloys containing various percentages of lead, it was found that a composition of 86 per cent. copper, 3 per cent. lead, 3 per cent. tin and 8 per cent. zinc could be used without the formation of this deposit. Such an alloy was recommended to this foundry for all future castings to be used in contact with tap water, and an added suggestion was made that the entire subject be investigated from a health standpoint because of the ill effects of lead on the human system.

Mixed Foundry Problems

The Ajax Company sometimes receives calls for service from companies operating brass foundries in conjunction with grey iron foundries. In a number of instances their difficulties have been due to attempts to produce brass castings with the same pattern equipment used for grey iron. On several occasions, this company has conducted investigations in regard to this and has found that the pouring basins were located directly in the centre of the mould. This made it necessary for the pourer to raise the ladle to an elevation of about 7 or 8 in. above the basin, with the result that when the brass was poured in this manner, the metal was greatly agitated and excessive dross was formed. This does not occur when grey iron is poured under the same conditions.

On every occasion, it is recommended that for brass castings, the gating be changed and that the gates be located on the edge or the end of the pattern, so that the pouring ladle can be held sufficiently close to the basin, thus minimising agitation of the metal. This example clearly indicates that brass castings cannot be successfully produced by the same method of gating as is employed for grey iron.

Fluxes

An example of the improper use of fluxes may be clearly shown by consideration of the following problem and its solution:—

In a foundry engaged in the production of miscellaneous valves and fittings, with an alloy of 85 per cent. copper, 5 per cent. lead, 5 per cent. tin and 5 per cent. zinc, a considerable percentage of castings were found to be defective due to porosity. Their melting equipment consisted of oil-fired open-flame tilting furnaces of 1,000 lbs. capacity. The metal was transferred to ladles holding approximately 200 lbs. of metal and thence to the sand moulds.

TABLE I.—*Typical Furnace Charge for Valves and Fittings.*

	Lbs.	ozs.
85-5-5-5 ingot	440	0
85-5-5-5 gates	350	0
85-5-5-5 borings	140	0
Electrolytic copper	57	1
Tin	0	5
Lead	4	0
Zinc	18	13
Boron copper	5	0
50-50 copper-nickel shot	5	0
Calcium chloride	6	0
Borax	2	0
Salt	2	0

This foundry reported having difficulty over a long period of time during which they purchased composition ingot metal from nearly all of the large producers. Requests for service were made in almost every instance, and this resulted in representatives of the various ingot metal manufacturers visiting them and investigating their difficulties. In almost every case the customer was advised to add a flux of some nature to the metal with the assurance that the trouble would thereafter cease. This practice was continued, until at the time of the first purchase of Ajax metal, they were adding as many as eight different fluxes to each heat. In addition to this, it was their practice to calculate a theoretically perfect 85-5-5-5 furnace charge, which made necessary the addition of small amounts of virgin metals to the composition ingot, notwithstanding the fact that their analysis of the ingot metal supplied to them was well within the allowable limits of their specification.

The data in Table I are a typical furnace charge for the 85-5-5-5 mixture being used at the time. To each ladle the following additional fluxes were added:—

	Ozs.
15 per cent. phosphor-copper shot	2
Lead oxide	2
Charcoal (approx.)	3

Upon further investigation, it was found that most of the defective castings were due to slag inclusions which no doubt were caused by the excessive amount of slag-forming fluxes added to the metal.

It was recommended that a furnace charge be made up consisting of Ajax ingot metal, gates, borings and the elimination of all fluxes with the exception of a small amount of covering flux, that is, 2 lbs. of borax per 1,000 lbs. heat and the use of 2 ozs. of 15 per cent. phosphor-copper to each ladle. Subsequent heats produced from this mixture gave very satisfactory results, and the percentage of defective castings was reduced from approximately 20 per cent. to not more than 3 or 4 per cent.

In the final discussion with the men at this plant regarding the above unusual practice of using so many fluxes, it was revealed that the 50-50 copper-nickel shot was recommended for the purpose of closing the grain structure; that the boron-copper, phosphor-copper shot and charcoal were used as deoxidisers; that the calcium chloride and salt were recommended to counteract the effect of a possibly high sulphur content in the fuel oil. The lead oxide was recommended for use on the assumption that the porosity was due, not to oxidation, but to the possible presence of reducing gases in the metal.

Oxidation Troubles

Oxidation of metal during melting is often responsible for defective castings. In a foundry engaged in the production of mine pump bodies and impellers, considerable difficulty was encountered from porous castings. Composition ingot metal of the formula 75 per cent. copper, 15 per cent. lead and 10 per cent. tin was used for their metal requirements.

The porosity was confined chiefly to large impellor castings, which varied greatly in cross-section. The porosity was found chiefly at the hub or heaviest section of the casting. Small impellers and other castings which were more uniform in cross-section, were produced without any trace of these defects. The porosity appeared to be mainly a surface condition, penetrating to an average depth of approximately $\frac{1}{4}$ in., with a maximum penetration of about $\frac{1}{8}$ in. Examination of one of the large defective impellers revealed that the porosity occurred only at points where the metal came in contact with the core, and where the metal came in contact with the skin-dried surface of the mould.

It was first thought that the difficulty was due to the use of improperly baked and vented cores. Subsequent experiments failed to support this contention. Attention was then directed to the melting practice. This consisted of melting in natural-draft pit furnaces, using hard coal for a bed and coke around the sides of the crucible. Size No. 100 graphite crucibles were used and the average furnace charge was 500 lbs. per heat. All moulds were poured direct from the melting crucible.

The melting time per heat was approximately 3 hrs. and the metal when in the molten condi-

* Extracted from a Paper presented to the Philadelphia Chapter of the American Foundrymen's Association. The author is Metallurgist, Ajax Metal Company.

tion appeared to be sluggish and showed an excessive amount of dross, and, as a result, constant skimming was necessary to clean the metal thoroughly before pouring.

Furnace Design Changed

It was quite evident that the metal was highly oxidised and that the melting practice was at fault. Investigation showed that the area of the flue from the furnace to the stack was 8 by 6 in., or an area of 48 sq. in. This appeared to be too large and not consistent with good furnace design. The flue was therefore reduced to an area of 36 sq. in. and further melts were made. This change in flue area immediately produced good results. Subsequent heats were observed in the molten condition and the metal was clean and free from dross, and had good fluidity. Only a normal amount of skimming was necessary. Examination of several large impellers thus produced revealed that the castings were sound and free from porosity. The solution to this problem may be explained by the metal becoming oxidised in the furnace during melting, because of the excessive area of the flue. This permitted an excessive amount of air to enter the furnace, which was absorbed by the metal. The gas thus absorbed was liberated during solidification of the metal in the mould and, in attempting to escape, was forced to the heaviest section, or that part of the casting which was last to solidify, this being the section the surface of which was next to the core.

When a casting is observed containing some defect, a statement of "bad metal" is made in many instances. Although some foundrymen make this statement, whenever they get into difficulties, it has been the writer's experience, which covers many years in attempting to solve foundry problems, that when the real difficulties are unearthed, in less than 1 per cent. of the cases involved was the trouble due to "bad metal."

Conclusions

In closing, it is apparent that the methods of procedure to be used in the solution of non-ferrous foundry problems resolves itself into the following two general classifications:—

(1) A close inspection of a defective casting, together with a study of the foundry practice, will in many cases indicate to the experienced investigator the probable cause of the trouble, and a well directed change in procedure will usually result in the production of sound castings.

(2) When the above method of procedure fails to attain the desired objective, it then becomes necessary to attack the problem by a process of elimination. This first requires the establishment of standard foundry practice, namely, that all phases of production should be the same for every heat, such as character of charge, type of furnace, melting time, pouring temperature, moulding practice, etc. By varying only one of these phases at a time, keeping all other conditions constant, and with a study of the results, the cause of the trouble may be finally isolated. Having thus found the cause of the defect, corrective measures can then be applied for its elimination. While such procedure is looked upon by some foundrymen as being impracticable, costly and interfering with production, the time and effort thus expended may be more than compensated for by the savings resulting from the solution of the problem involved.

Industrial Activity

Industrial activity in the United Kingdom in the first quarter of 1937, as estimated from the particulars furnished from various sources to the Board of Trade, was 0.2 per cent. less than in the fourth quarter of 1936, but 7.1 per cent. greater than in the first quarter of 1936. The index numbers for the three periods (based on the quarterly average 1930 equals 100) are 131.9, 132.1 and 123.2 respectively.

American Industrialists to Study British Research Organisation

Between twenty and thirty important American executives and bankers arrived at Southampton last Monday to tour Great Britain, France and Germany to study European research organisation at first hand. The tour has been arranged under the auspices of the American National Research Council by Mr. Maurice Holland, the director of the Division of Engineering and Industrial Research of the Council.

The tour in this country has been arranged in co-operation with the Department of Scientific and Industrial Research, and visits will be made to the National Physical Laboratory, where the party will be received by Lord Rutherford and members of the Department's Advisory Council; the Building Research Station and the Fuel Research Station. The party will also spend a day at the Shirley Institute, the headquarters of the Cotton Research Association at Didsbury, and, apart from visiting the laboratories of the leather, the boot and shoe and the rubber Research Associations, it is visiting the research laboratories of several large firms. Its members will see research on the production of drugs and medicines in London, electrical research in Manchester and Wembley, research on iron and steel in Sheffield and on non-ferrous metals in Birmingham.

The party will visit the Cavendish Laboratory at Cambridge, where it will be entertained to lunch at Trinity College. Before leaving for Paris on June 7, time will also have been found to visit the Lake District, Shakespeare's Country, Windsor and Hampton Court. After leaving England, an equally strenuous programme has been planned in France and Germany before the party returns to America on June 30. During the tour, about thirty-five laboratories will have been visited, covering eighteen different fields of industrial research.

American Foundrymen's Association

(*Concluded from page* 430.)

and the practical application of research to the advancement of the foundry industry.

The William H. McFadden gold medal has been awarded to Mr. C. W. Briggs, U.S. Naval Research Laboratories, Anacostia, Washington, D.C., for his direction of important research and published writings on metallurgy, of great value to steel castings producers. The J. H. Whiting gold medal has been presented to Dr. J. T. MacKenzie, American Cast Iron Pipe Company, Birmingham, in recognition of his research and practical work in the advancement of grey iron foundry practice.

Formal presentation of these medals was made on May 6 at the annual banquet of the Association, held in connection with the Forty-first Annual Convention and Exhibition. Mr. James L. Wick, jun., Falcon Bronze Company, Youngstown, who presided, introduced three former Presidents of the Association, who delivered the presentation addresses. The Penton medal was presented by a Past-President, Mr. E. H. Ballard, General Electric Company (American), West Lynn, Massachusetts; the McFadden medal address was given by another Past-President, Major R. A. Bull, foundry consultant, Chicago; while the Whiting medal, offered through a gift of the late Mr. J. H. Whiting, was given by a third Past-President, Mr. Dan M. Avey, chairman of the Board of Awards, now secretary of the American Foundrymen's Association.

MR. W. H. SCOTT, who founded in 1883 the firm which is now Laurence, Scott & Electromotors, Limited, was entertained to dinner at Norwich on Thursday, May 13, in celebration of his 75th birthday.

International Foundry Congress in Paris

The International Foundry Congress, which is being held from June 17 to 24 in Paris, will, for its technical sessions, be held at the Hôtel des Ingenieurs des Arts et Métiers, 9 bis, Avenue d'Iéna, Paris 16. The detailed programme is as follows:—

THURSDAY, JUNE 17.

10 a.m. to 6 p.m.—Registration.

9 p.m.—Reception by the Committee of the Association Technique de Fonderie.

FRIDAY, JUNE 18.

10 a.m.—Official opening by the Under-Secretary for Technical Education. Address by Mr. Luc, Inspector of Technical Education on "Technical Training and the French Foundry Industry."

12.30 p.m.—Opening Luncheon.

3 p.m.—Visit to the International Exhibition of Art and Technology—conducted tour of the Palace of Invention. Reception by the general manager of the Exhibition.

SATURDAY, JUNE 19.

9.30 a.m.—Technical Session. Ladies.—Free morning.

12.30 p.m.—Congress Luncheon.

3 p.m.—Joint Session with the Foundry Friendly Association, exhibition of foundry films. Ladies.—Tour of Paris in the afternoon.

10 p.m.—Dance, organised by the Foundry School Old Students' Association.

MONDAY, JUNE 21.

9.30 a.m.—Technical Session. Ladies.—Morning free.

12.30 p.m.—Congress Luncheon.

2.30 p.m.—Technical Session. Ladies.—Visit to the Open-Air School and the Garden City at Suresnes (social work created by M. Sellier, Minister of Health).

5 p.m.—Reception by the Paris Chamber of Commerce.

TUESDAY, JUNE 22.

9.30 a.m.—Visit to the Laboratories of the Central School of Arts and Manufactures. Reception by Mr. L. Guillet, Membre de l'Institut, Director of the School. Ladies.—Morning free.

12.30 p.m.—Congress Luncheon.

3 p.m.—Visit to Ma maison Chateau. Tea at St. Germain (Henri IV Pavilion).

9 p.m.—Visit to the newly-lighted galleries of the Louvre Museum.

WEDNESDAY, JUNE 23.

9 a.m.—Visit to the French Foundry School and the Research Institute.

11 a.m.—Reception by the Paris City Council.

12.30 p.m.—Congress luncheon.

3 p.m.—Technical session. Ladies.—Visit to the Bagatelle Roseraire. Mannequin parade by some of the great French dressmaking establishments. Tea.

THURSDAY, JUNE 24.

9 a.m.—Visit to the locomotive testing beds at Vitry sur Seine.

12.30 p.m.—Congress luncheon.

3 p.m.—Lecture by Professor Pisek of Czecho-Slovakia on the "International Importance of Industrial Research." Closing session. Award of medals.

8 p.m.—Closing banquet at the Pavillon Dauphine.

Works visits are to be organised as far as possible for the period of the conference and their details will appear on the notice board at the Congress office.

International Committee Meetings

June 19. 5.30 p.m.—International Testing of Cast Iron Committee.

June 23. 4 p.m.—International Dictionary Committee; 5.30 International Technical Committee.

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TOTAL CARBON	2·60%
SILICON	·75%
MANGANESE	·50%
SULPHUR	·05%
PHOSPHORUS	·06%

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The Week's News in Brief

Trade Talk

A NEW IRON AND STEEL WORKS is being erected in Southern Rhodesia.

CORNTHWAITE & JANE, LIMITED, have erected a new foundry at Germiston, South Africa.

A NEW WORKS for the manufacture of light malleable-iron castings and washers is being erected at Blaina, South Wales.

WORKMEN'S BATHS have been provided in the East Works of Brown Bayley's Steel Works, Limited, Attercliffe, Sheffield.

AN IMPORTANT DISCOVERY of iron ore has been made in the Malay State of Johore, where iron mines are extensively worked by the Japanese.

WILLIAM GRAY & COMPANY, LIMITED, West Hartlepool, have received an order from the Ellerman's Wilson Line for a fast cargo ship of 4,300 tons.

MEMBERS OF THE Falkirk Branch of the Electrical Association for Women visited the Falkirk Iron Works of the Falkirk Iron Company, Limited, last week.

TWO FURNACEMEN were badly burned at the Balbardie Works of the North British Steel Foundry Company, Limited, Bathgate, last week, when a quantity of metal was projected from the mouth of a Stock converter.

INNISS & RIDDLE (CHINA), LIMITED, have been awarded the contract for the equipment of the new locomotive and rolling stock repairing shops at Chuchow. This contract includes the supply of all foundry plant, machine tools and mobile cranes.

LAST TUESDAY the Mayor of Warrington (Councillor J. T. Cooper, J.P.) opened the new foundry of Warrington Light Castings Company, Limited, by opening the tap-hole of the cupola. We shall give further details of this ceremony and the foundry next week.

A FURTHER MEETING of the Welsh Engineers' and Founders' Conciliation Board was held in Swansea last Saturday. The employees are asking for a wage increase of 4d. per hour. The meeting was held in private, but it is believed that the employers' final offer to the men was in the nature of a sliding scale. A further meeting will probably be held next week.

DETAILS OF THE OPERATION of the "scrap and build" shipping scheme issued by the Ships Replacement Committee show that in less than two years the British mercantile marine benefited by the construction of 50 new vessels of approximately 186,000 tons gross. The total estimated cost of these vessels was £3,664,360, and advances of £3,548,124 were sanctioned by the Treasury. The committee states that the scarcity of ships for scrapping was throughout the principal difficulty in the way of the scheme. Few applicants were able to offer tonnage of their own for demolition. The majority of the applicants had to go into the open market for the obsolete tonnage which they required. Suitable tonnage was never plentiful, and applicants always had to pay a premium over the scrap value, this premium becoming increasingly heavy as time went on. In connection with the proposals finally sanctioned, 97 vessels, of 386,625 tons gross, were nominated for demolition. At the date of the report (March 15, 1937), 94 vessels, totalling 374,707 tons gross, had either been demolished or had been disposed of to shipbreakers. Fifty-five vessels, totalling 204,102 tons gross, had gone to shipbreakers in the United Kingdom and 39, totalling 170,605 tons gross, had been sold to shipbreakers abroad. Of the latter the main sales were to the following countries:—Japan, 57,997 tons gross; Italy, 46,426 tons; Holland, 19,562 tons; Germany, 14,040 tons; Danzig, 12,862 tons. Other sales were to shipbreakers in Sweden, Belgium, Denmark, Irish Free State, Latvia and Norway.

PROGRESS OF THE WORKS reconstruction programme is reviewed in the report of the directors of the Park Gate Iron & Steel Company, Limited. A Ruths' Arca feed-water accumulator has been erected with the object of maintaining boiler pressure at a uniform level. In the steel-melting shop further siding provision for marshalling materials ready for charging the furnaces has been added, and the casting pit enlarged from end to end, and equipped with electrically-driven ladle carriages. This work occupied all the first half of the year, during which production was with great difficulty maintained at the average of 1936. In the second half of the year production rose by about 1,000 tons a week to an average of 5,300 tons; it is confidently hoped that it can be increased to 6,000 tons per week or 300,000 tons per year. The slab and billet mills have both been modernised, with the result that outputs considerably exceeded previous records. A slab-charging machine has been added to No. 1 plate mill, with considerable benefit, but the reconstruction of the mill train has not yet been started. No. 2 plate mill and No. 4 sheet mill have been changed over to electric drive. In both cases the mill equipment was overhauled and further normalising furnaces were installed, all with satisfactory results. The railway system has been completely redesigned and reconstructed, and three new locos have been added to deal with the increased inwards and outwards traffic. The work at present under construction includes a Lodge-Cottrell electrostatic gas-cleaning plant for purifying the blast-furnace gas, and a feed-water treatment plant. The No. 1 blast furnace is being rebuilt in order to increase its output. Further improvements to be carried out are the reconstruction of the No. 1 plate-mill roll train, an addition to the research department and the extension to the building of the 12-in. bar mill.

Personal

MR. A. ROUSSEAU, general manager of our esteemed contemporary—"Revue de Fonderie Moderne"—has been created a Chevalier of the Legion of Honour.

DR. J. W. MELLOR, F.R.S., President of The Institute of Vitreous Enamellers, has been elected the first President of the British Refractories Research Association. Unfortunately, Dr. Mellor's health is at present preventing him from participating fully in his activities.

MR. J. P. YOUNG has been appointed assistant to the foundry manager at the Caledonian Foundry Company, Limited, Greenock. He was foreman with Messrs. Jas. Howden, Limited, Glasgow, until early in 1936, when he went to Messrs. Samuel White & Company, Cowes, I.O.W.

MR. CHARLES DUNNING last Tuesday paid a visit to Wright's Havelock Foundry at Leicester, where he was once an apprentice moulder. On this occasion he was able to meet the managing director, Mr. W. H. Wright (Mr. S. H. Russell's father-in-law); Mr. Alfred Tomlin, his old foreman; Mr. Harry Chapman; Mr. Leonard Noble; Mr. Joe Flavell and Mr. Harry Flint, his old colleagues, some of whom have now retired.

Obituary

MR. JAMES SMITH, who last year completed fifty years' service with Glenfield & Kennedy, Limited, Kilmarnock, died on May 20.

MR. ARTHUR FREDERICK BENNETT has died at Leiston, Suffolk, at the age of 64. Mr. Bennett spent his early life at Goole. For several years he was on the engineering staff of Earle's Shipping & Engineering Company at Hull. Afterwards he became general manager of Willans & Robinson, of Rugby, leaving to become general manager of Richard Garrett Engineering Works, Limited, at Leiston, a position from which he retired a few years ago.

MR. JAMES WHITBY, for many years a well-known figure in the steel-sheet trade, died on Friday, May 14, at the age of 69. When Mr. Whitby retired from active business two years ago, he relinquished the post of London manager of John Summers & Sons, Limited, and other companies with whom he had been associated for many years. He retained, however, the chairmanship of the Anti-Attrition Metal Company, Limited, and also continued to be actively associated with several trade organisations. He was chairman of directors of the London Iron and Steel Exchange, of which he was a founder, and chairman of the Metal Trade Section of the London Chamber of Commerce. During the war he was one of the four advisers to the Board of Trade on import restrictions, and was chairman of the Iron and Engineering Section of the Red Cross. He was also a member of many other war committees appointed by Parliament, and of the committee of management of the Royal Metal Trades Pension and Benevolent Society.

Company Reports

Howard & Bullough (Securities), Limited.—Profit for year to March 31, £18,264; brought in, £155; transferred from dividend reserve, £9,500; dividend on the ordinary shares of 1¾ per cent.; carried forward, £169.

Park Gate Iron & Steel Company, Limited.—Gross profit for year to March 31, after providing for taxation, £108,108; brought in, £28,196; written off for depreciation, £40,000; dividend of 3½ per cent., £52,500; to reserve, £15,000; carried forward, £28,804.

Leeds Piston Ring & Engineering Company, Limited.—Net profit for half-year to March 31, £9,955; profits amounting to £3,570 earned prior to incorporation have been transferred to capital reserve; income tax, £1,786; dividend of 4½ per cent. actual; carried forward, £1,838.

British Bedaux, Limited.—Gross profit for period March 16, 1936, to March 31, 1937, £44,496; net profit after depreciation, fees and tax, £32,911; interim dividend, £9,150; final dividend of 8 per cent., making 12 per cent., £18,000; to reserve, £4,000; carried forward, £1,761.

Peglers, Limited. — Profit, £74,464; brought in, £3,592; dividend on the preference shares for the year ended March 31, £4,290; to general reserve, £20,000; to income-tax reserve, £12,000; to employees' bonus account, £3,500; dividend on the ordinary shares of 1s. 6d. per share, £33,472; carried forward, £4,793.

Platt Bros. & Company (Holdings), Limited.—Balance on profit and loss account, £86,001, which includes certain reserves not required; net balance after fees and debenture interest, £54,313; capital profits amounting to £8,522 have been added to capital reserve; carried forward after dividends on the 4½ per cent. preference shares, £35,034.

British Oxygen Company, Limited.—Consolidated profit for 1936, after deducting depreciation of fixed assets and amounts written off cylinders, by the company and by the subsidiary companies proportionate to the company's holdings in those companies, £694,372; company's proportion of the profits retained by subsidiary companies for special appropriations, allocations to reserves, and undistributed profit balances, £94,093; balance of profit (including the profits of subsidiary companies to the extent to which dividends have been declared), £600,279; brought in, £22,399; dividend on the preference stock for the year, £32,500; interim dividend on the ordinary stock of 7 per cent., £173,997; contributions to staff and works pension funds, £29,327; to general reserve, £25,000; to reserve against buildings and plant, £50,000; to special taxation reserve, £50,000; directors recommend that £177,578 standing at the credit of general reserve account be capitalised and distributed to the ordinary stockholders as a free bonus in the proportion of one share for every £15 ordinary stock held; final dividend of 8 per cent. on the ordinary stock, including the bonus issue; carried forward, £34,554.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Lloyd & Ross, Limited, 107, Upper Thames Street, London, E.C.4.—Capital, £1,500. Ironfounders, engineers, etc. Directors: A. D. Ross and J. D. Morrison.

Davy Bros., Limited, Park Ironworks, Foley Street, Sheffield, 4.—Capital, £100. Engineers, rollers of steel, etc. Directors: G. Sturt and H. M. Sutherland.

Industrial Equipment, Limited.—Capital, £1,000. Ironfounders, steelmakers, and blast furnace proprietors. Subscribers: Robert L. Renfrew, solicitor, and Robert Sinclair, solicitor, Glasgow.

Forthcoming Events

Institute of British Foundrymen
JUNE 8 TO 11.
Thirty-fourth Annual Conference in Derby.
JUNE 17 TO 24.
International Foundry Congress in Paris.

For **"easy stripping"** use

YORKSHIRE SAND

Yorkshire Sand is of a synthetic nature, its production being under careful laboratory control. Perfect standardization is obtained with the various grades, suitable for light and the heaviest steel castings.

It is because of the refractoriness of the sand and of the toughness of the mould surface that castings made with Yorkshire Sand are distinguishable by their excellent finish.

Please address all enquiries to the nearest Sales Office :

GENERAL REFRACTORIES LTD.,

Genefax House, Sheffield

Telephone : *Sheffield 31113 (6 lines).*

Telegrams : *"Genefax, Sheffield."*

LONDON OFFICE: Russell House, Adelphi, W.C.2.
Telephone: Temple Bar 7361. Telegrams: "Genefax, Rand-London." Mr. A. C. Turner.

SCOTTISH OFFICE: 48, West Regent Street, Glasgow. Telephone: 3009. Telegrams: "Genefax, Glasgow." (Mr. C. A. G. Thomson.)

MANCHESTER OFFICE: 9, Albert Square, Manchester, 2. Telephone: Blackfriars 6130. Telegrams: "Genefax, Manchester." (Mr. S. G. Throssell.)

SWANSEA OFFICE: Metropole Chambers, Wind Street, Swansea. Telephone: 3680. Telegrams: "Genefax, Swansea." (Mr. D. Hood-Williams.)

CARDIFF OFFICE: 17, Windsor Place, Cardiff. Telephone: 8796. Telegrams: "Genefax, Cardiff." (Mr. F. E. Rutter.)

MIDDLESBROUGH OFFICE: Halifax Buildings, Exchange Place.
Telephone: Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough."

★

Read what an IMPORTANT STEELFOUNDER says :—

"During the 40 years I have been connected with Steel Foundry work, considerable changes have taken place. Away back, we had Steel Moulders' Composition, Old Crucible Pots, etc., and each works claimed to have its own 'secret' moulding composition. High Silica Sand has eliminated practically all these from many foundries and to-day we have your 'Yorkshire Sand' which acts almost like a chill, and leaves the skin of the casting blue-black and as clean as cast iron.

The hot steel lies quietly against the wall of sand, and often when the casting has been lifted out of the mould, the latter looks as if it could be used over again, just like a permanent mould."

Raw Material Markets

Less relief than is usual was afforded to the iron and steel markets by the Whitsuntide holiday, as most plants continued to operate to capacity. As a rule, there is a wide-spread stoppage, and the opportunity is taken to carry out repairs and improvements over a Bank holiday, but, this time, only the plants which found it absolutely essential to make renovations closed down. Outputs are at record heights, but the demand is unabated and new business is extremely difficult to place.

Pig-Iron

MIDDLESBROUGH.—Deliveries have been somewhat heavier recently, as some consuming plants were idle over the Whitsun holiday. A large tonnage of iron continues to come into this area from the Midlands, but, even so, supplies are nothing like sufficient to satisfy the existing demand. No new business can be considered until the revised scale of prices is announced. It is hoped that these will be available within the next few days. Meanwhile, quotations are nominal, and are based on No. 3 Cleveland G.M.B. at 81s. per ton delivered in the Middlesbrough district. The inquiry for hematite during the past week has been on a heavy scale, but new contracts have been disappointingly few. It had been fully expected that producers would be more willing to dispose of their outputs over the second half of the year following the publication of the higher quotations, but orders generally have been difficult to place. Home prices, which are subject to a rebate of 5s. per ton, are based on East Coast hematite mixed numbers at 122s. 6d. per ton in the Middlesbrough area, 120s. in South Wales, 128s. in Sheffield, and 133s. 6d. in the Midlands.

LANCASHIRE.—Apart from the textile-machinery makers, all consumers of pig-iron are actively employed and are not slow to complain that deliveries from the furnaces are insufficient to enable them to maintain full-time working. Producers, admittedly, are not despatching iron according to specifications, but all users are receiving supplies based on their previous requirements. West Coast hematite is in short supply and is quoted at 131s., with East Coast material at 130s. 6d. Good Scottish No. 3 foundry iron is available only in small tonnages, and quotations are around 135s., delivered equal to Manchester.

MIDLANDS.—While it is hoped that the announcement with regard to higher foundry iron prices—when it comes—will facilitate the transaction of business, it is generally known that many producers are not in the position to entertain new orders, as they are heavily committed for a considerable time. In view of the outlook at home, some consumers have decided to try their lot overseas, and it is understood that ironfounders have procured high-phosphoric iron from the Continent at prices varying between £7 15s. and £8, and also low-phosphorus pig-iron from the United States at from £7 17s. 6d. to £8 10s. per ton, delivered works in South Staffordshire. Supplies of the better class irons in this country are difficult to obtain and low-phosphorus iron, for delivery to this area, is around £6 5s., minimum, with refined iron at from £7 15s. to £8 10s. Forge iron is heavily inquired for at 5s. per ton less than the figure for ordinary No. 3 foundry iron. In some cases, business has been done in hematite involving deliveries up to the end of the year, but, generally speaking, the end of September limits current orders. For delivery to Birmingham and Black Country stations, West Coast mixed numbers are quoted at £6 14s. 6d. and East Coast No. 3 at £6 13s. 6d., subject to the usual rebate. For delivery into works, an extra of 1s. 6d. per ton is invoiced.

SCOTLAND.—Makers are not disposed to enter into contracts involving substantial tonnages, and business recently has consisted of small parcels for early delivery. No. 1 foundry is quoted at 115s. 6d., with No. 3 at 113s., f.o.t. furnaces. Cleveland iron is nominal at 84s. f.o.t. Falkirk and 87s. f.o.t. Glasgow. Local steelworks are quite unable to obtain the necessary supplies of pig-iron. Mixed numbers of hematite are quoted at 123s., and basic, British and Indian, at 107s. 6d., both less 5s. per ton rebate and delivered steelworks.

Coke

Firm conditions continue to prevail on the foundry-coke market, and still higher prices are anticipated. For delivery to Birmingham and district, best Durham coke is quoted at a minimum of 46s. 6d. per ton, although, in order to obtain supplies, consumers have paid around 50s. Welsh coke is quoted at 48s. 6d. to 60s., according to quality.

Steel

The steel market has settled down following the Whitsun holiday, and the demand in all departments is as strong as before the break, says the official report of the London Iron and Steel Exchange. The recent advance in quotations has not affected the situation, and consumers continue to experience considerable difficulty in finding producers able to accept orders for reasonably near delivery. Most of the new business negotiated is for delivery over the second half of the year, and in many cases the steelmakers are unable to promise execution before October. In some departments, however, an impression seems to have been made upon the accumulated arrears. A little relief has been experienced from the stringency in supplies of semi-finished steel, but operations at the consuming works are restricted by the scarcity of certain classes of material. The imports of Continental billets against the quota have increased lately, but there remain heavy arrears to be made up. In the finished steel department, there is unrelieved pressure on the part of consumers to obtain material, and a heavy tonnage of business is offering. The export demand is sustained, but a considerable amount of this business has had to be declined owing to the extent of home requirements.

Scrap

After protracted negotiations between the various parties concerned, it would appear that at long last the control scheme for steel scrap is in working order. From the Cleveland area, it is reported that the membership of the merchants' association is 100 per cent. This, of course, is the only way in which maximum results can be obtained. The new prices make allowances for tonnage and quality. Best quality steel scrap is at 69s. per ton, with Nos. 2 and 3 grades at 67s. and 62s. respectively. The demand for these grades remains far in excess of the available supply. Heavy machinery metal also is in short supply at 87s. 6d., and higher figures have been paid. Good, heavy cast iron is at 85s., while clean light iron is at 72s. 6d. The supply position has further improved in South Wales. There is a good turnover in heavy steel scrap at 68s. to 70s., while a fair tonnage of bundled steel scrap has been disposed of at 63s. to 65s. Heavy cast iron in large pieces and furnace sizes is difficult to obtain at 68s. to 70s. Good cast-iron machinery scrap in foundry sizes is quiet at 75s. to 80s. per ton. Reports from the Midlands state that more business has been done at around the following prices :—Heavy melting scrap in furnace sizes, 60s.; heavy machinery scrap, 80s. to 85s.; good heavy, 77s. 6d. to 80s.; short, heavy steel, suitable for foundry work, 75s. to 80s.; all delivered works. Consumers in the Scottish area are dependent to a large extent on supplies from abroad, and it is hoped that additional tonnages will arrive in the near future. Heavy steel scrap in furnace sizes is unchanged at 64s. 6d. to 67s., with heavy basic, or heavy iron and steel scrap mixed, at 62s. 6d. to 65s., according to quality and quantity, while medium basic is 57s. 6d. to 60s. Good quality machinery cast-iron scrap, in pieces not exceeding 1 cwt., is quoted around 95s., and for ordinary cast iron, to the same specification, the price is 90s. per ton, delivered consumers' works.

Metals

Conditions on the non-ferrous metal markets during the past week have been stronger than of late, and sentiment has been more favourable all round. It is difficult to attribute the better tone to any particular cause or causes, as trade buying has not been substantial, nor is the outlook in this respect a reason for the firmer conditions.

Copper.—The reasons for the departure for Europe of Mr. F. Kelley, president of the Anaconda Copper Mining Company, and Mr. Carl T. Ulrich, vice-president of the Kennecott Copper Corporation, are variously conjectured in New York. It is stated that both are to attend a conference of the International Copper Cartel in London to consider bringing about a moderate reduction in the near future in copper production, while another report is that the British Government, in view of its armament programme, is against a resumption of restrictions on copper production at this time. From all accounts it would seem probable that the scheme for the restriction of copper output has, in fact, been abandoned, at least for the present. A firmer tone has been evident in the market recently, but buying on trade account does not seem to have been particularly brisk. In the United States, a larger tonnage has changed hands. It is generally anticipated that consumers there will soon have to re-enter the market, and that when the time comes buying will involve heavy tonnages. It is expected in New York that the import duty on foreign copper, the authority for which lapses on June 30, will be continued at the current level. It is stated that the Administration intends to recommend the extension of the tax to Congress, possibly for two years.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £62 2s. 6d. to £62 5s.; Friday, £61 5s. to £61 10s.; Monday, £62 to £62 5s.; Tuesday, £63 5s. to £63 10s.; Wednesday, £61 10s. to £61 12s. 6d.

Three Months. — Thursday, £58 10s. to £58 12s. 6d.; Friday, £59 5s. to £59 7s. 6d.; Monday, £59 17s. 6d. to £60; Tuesday, £60 18s. 9d. to £61; Wednesday, £59 16s. 3d. to £59 17s. 6d.

Tin.—It is reported from Amsterdam that a Bill has been introduced in the Second Chamber giving effect to the fusion of the Government-owned Banka tin mines and the Billiton Tin Mining Company into a new company, "Venit." with a capital of Fl.55,000,000, of which Fl.49,500,000 of "A" shares will be held by the Netherlands East Indies Government and Fl.5,500,000 of "B" shares by the Billiton company. The latter company is to be manager of "Venit." It will be recalled that the Netherlands East Indies People's Council some time ago rejected the proposal by 43 votes to 7, but the Netherlands East Indies has only advisory powers. The fate of the Bill depends largely on the composition of the Second Chamber after this week's election. In its memorandum with the Bill, the Government states that the Council's vote was overridden for reasons of economy and because the proposed fusion would improve the financial position of Banka. Tin consumers throughout the world are displaying little active interest at the present time, although consumption remains on an excellent scale.

Official quotations were as follow :—

Cash.—Thursday, £250 5s. to £250 10s.; Friday, £252 15s. to £253 5s.; Monday, £253 10s. to £254; Tuesday, £253 to £253 5s.; Wednesday, £252 to £252 5s.

Three Months.—Thursday, £248 7s. 6d. to £248 12s. 6d.; Friday, £250 15s. to £251 5s.; Monday, £252 15s. to £253; Tuesday, £252 to £252 5s.; Wednesday, £250 15s. to £251.

Spelter.—The weekly review of the metal markets by Rudolf Wolff & Company states that the lower prices and the rather more settled appearance of markets generally have attracted buyers of spelter. "Liquidation, moreover, would appear to have spent itself. Business with consumers, owing to the intervention of the recent holidays, has been on a reduced scale, and some improvement therefore in this direction might reasonably be anticipated. Consumption is reported to be good, with continued activity in the engineering and motor industries, while galvanisers also are said to be fairly well booked. In the circumstances it seems more likely that prices in the near future will fluctuate around current levels"

Daily market prices :—

Ordinary.—Thursday, £23 2s. 6d.; Friday, £23 12s. 6d.; Monday, £24 3s. 9d.; Tuesday, £23 18s. 9d.; Wednesday, £23 7s. 6d.

Lead.—Although the outlook remains uncertain, there has been a definite improvement in the tone of this market during the past week. A relaxation of selling pressure rather than an increased demand is given as the reason for the better conditions.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £24 5s.; Friday, £24 13s. 9d.; Monday, £24 13s. 9d.; Tuesday, £24 18s. 9d.; Wednesday, £24 7s. 6d.

B.A./40D ALUMINIUM ALLOY FOR LARGE CASTINGS

Ever since the value of a "modified" silicon alloy was discovered, we have supplied a rapidly increasing tonnage of our B.A. 40 D silicon alloy. Those who always use it are aware of its ease of casting, its fluidity, its high strength coupled with a quite unexampled degree of ductility. Those who have not yet tried it may find in this alloy the exact metal they have been seeking to solve their foundry difficulties.

We will gladly give further information to interested enquirers.

The illustrations show:

1. *Pouring the casting.*
2. *The rough casting being knocked out of the mould.*
3. *The finished casting.*

(These photographs are shown by courtesy of Messrs. William Mills, Ltd., Birmingham.)

THE British Aluminium CO. LTD

Head Office: ADELAIDE HOUSE, LONDON, E.C.4. Telephone: Mansion House 5561 & 8074 (6 lines). Telegrams: "Cryolite, Bilgate, London."

F.T.J. 27.5.37.

RAW MATERIALS—PRICE LIST

(Wednesday, May 26, 1937)

COPPER

	£	s.	d.
Standard cash	61	10	0
Three months	59	16	3
Electrolytic	64	10	0
Tough	63	10	0
Best selected	64	0	0
Sheets	93	5	0
India	76	15	0
Wire bars	64	5	0
Ingot bars	64	5	0
H.C. wire rods	70	10	0
Off. av. cash, Apr.	62	12	$1\frac{10}{11}$
Do., 3 mths., Apr.	60	18	$6\frac{27}{44}$
Do., Sttlmnt., Apr.	62	11	$8\frac{6}{11}$
Do., Electro, Apr.	67	10	$8\frac{2}{11}$
Do., B.S., Apr.	67	14	2
Do., wire bars, Apr.	68	9	$1\frac{1}{11}$

Solid drawn tubes .. .. $14\frac{1}{2}$d.
Brazed tubes .. .. $14\frac{1}{2}$d.
Wire .. .. .. $10\frac{1}{2}$d.

BRASS

Solid drawn tubes .. .. $12\frac{1}{2}$d.
Brazed tubes .. .. $14\frac{1}{2}$d.
Rods, drawn .. .. 11d.
Rods, extd. or rlld. .. .. $7\frac{1}{2}$d.
Sheets to 10 w.g. .. .. $10\frac{1}{2}$d.
Wire .. .. .. $10\frac{1}{2}$d.
Rolled metal .. .. $9\frac{1}{2}$d.
Yellow metal rods .. .. $7\frac{1}{4}$d.

TIN

Standard cash	252	0	0
Three months	250	15	0
English	252	0	0
Bars	254	0	0
Straits	253	0	0
Eastern	254	10	0
Banca (nom.)	253	10	0
Off. av. cash, Apr.	267	8	$7\frac{7}{11}$
Do., 3 mths., Apr.	264	4	$10\frac{7}{11}$
Do., Sttlmt., Apr.	267	7	$11\frac{5}{11}$

SPELTER

Ordinary	23	7	6
Remelted	21	0	0
Hard	20	10	0
Electro 99.9	26	0	0
English	24	15	0
India	22	0	0
Zinc dust	32	10	0
Zinc ashes	9	5	0
Off. aver., Apr.	26	5	$7\frac{7}{44}$
Aver. spot, Apr.	26	4	$3\frac{9}{11}$

LEAD

Soft foreign, ppt.	24	7	6
Empire (nom.)	25	13	9
English	26	5	0
Off. aver., Apr.	25	18	$11\frac{1}{22}$
Aver. spot, Apr.	26	0	$3\frac{9}{22}$

ALUMINIUM

Ingots .. .. £100 to £105
Wire .. .. 1/3 to 1/4 lb.
Sheet and foil .. 1/2 to 1/4 lb.

ZINC SHEETS, &c.

Zinc sheets, English	36	10	0 to 37	0	0
Do., V.M. ex-whse.	36	10	0 to 37	0	0
Rods			30	0	0

ANTIMONY

English .. 82 10 0 to 83 10 0
Chinese, ex-whse. 69 10 0
Crude, c.i.f. 36 10 0

QUICKSILVER

Quicksilver 15 12 3

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—					
25%	13	0	0 to 14	10	0 (nom.)
45/50%	10	15	0 to 12	0	0 (nom.)
75%	15	15	0 to 17	0	0 (nom.)

Ferro-vanadium—
35/50% .. .. .. 12/8 lb. Va
Ferro-molybdenum—
70/75% carbon-free .. 4/9 lb. Mo.
Ferro-titanium—
20/25% carbon-free .. 9d. lb.
Ferro-phosphorus, 20/25% £21 to £22
Ferro-tungsten—
80/85% .. .. ..5/- lb. (nom.)
Tungsten metal powder—
98/99% .. .. ..5/3 lb. (nom.)
Ferro-chrome—
2/4% car. 32 17 6
4/6% car. 22 10 0
6/8% car. 21 10 0
8/10% car. 21 10 0
Ferro-chrome—
Max. 2% car. 32 10 0
Max. 1% car. 35 15 0
Max. 0.5% car. 36 10 0
70% carbon-free .. 9½d. lb.
Nickel—99.5/100% ..£180 to £185
"F" nickel shot £165 0 0
Ferro-cobalt, 98/99% .. 7/3 lb.
Metallic chromium—
96/98% .. .. .. 2/5 lb.
Ferro-manganese—
76/80% loose £16 15 0 to 17 5 0
76/80% packed £17 15 0 to 18 5 0
76/80% export £20 0 0
Metallic manganese—
94/96% carbon-free .. 1/3 lb.
Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten 2s. 7d.
Finished bars, 18% tungsten 3s. 6d.
Per lb. net, d/d buyers' works.
Extras—
Rounds and squares, 3 in. and over .. .. 4d. lb.
Rounds and squares, under ½ in. to ¼ in. .. .. 3d. lb.
Do., under ¼ in. to $\frac{3}{16}$ in. .. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in. .. .. 3d. lb.
Do., under ½ in. × ¼ in. .. 1/- lb.
Bevels of approved sizes and sections .. .. 6d. lb.
Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales (West)—						
Heavy steel, best	3	7	6 to	3	10	0
Mixed iron and steel ..	3	5	0 to	3	7	6
Heavy cast iron	3	7	6 to	3	10	0
Good machinery	3	15	0 to	4	0	0
Cleveland—						
Heavy steel, best	3	6	6 to	3	9	0
Steel turnings ..			..	2	12	6
Heavy cast iron ..			..	4	5	0
Heavy machinery ..			..	4	7	6
Midlands—						
Short heavy steel ..			..	3	15	0
Light cast-iron scrap ..			..	3	5	0
Heavy wrought iron ..	3	15	0 to	4	2	6
Steel turnings	2	2	6 to	2	5	0
Scotland—						
Heavy steel, best	3	4	6 to	3	7	0
Ordinary cast iron	4	7	6 to	4	10	0
Cast-iron borings	2	0	0 to	2	2	6
Wrot-iron piling	4	5	0 to	4	7	6
Heavy machinery	4	13	6 to	4	15	0

London—Merchants' buying prices, delivered yard.

Copper (clean) ..	51	0	0
Brass	32	0	0
Lead (less usual draft) ..	20	10	0
Tea lead	14	0	0
Zinc	14	0	0
New aluminium cuttings ..	74	0	0
Braziery copper	45	0	0
Gunmetal	46	0	0
Hollow pewter	155	0	0
Shaped black pewter ..	110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—

Foundry No. 1	83/6
,, No. 3	81/-
,, No. 4	80/-
Forge No. 4	80/-
Hematite No. 1	123/-*
Hematite M/Nos.	122/6*

N.W. Coast—

Hem. M/Nos. d/d Glas. ..	123/-*
,, d/d Birm.	134/6*
Malleable iron d/d Birm. ..	—

Midlands (d/d Birmingham dist.)—

Staffs No. 4 forge	83/-
,, No. 3 fdry.	86/-
Northants forge	80/6
,, fdry. No. 3 ..	83/6
,, fdry. No. 1 ..	86/6
Derbyshire forge	83/-
,, fdry. No. 3 ..	86/-
,, fdry. No. 1 ..	89/-

Scotland—

Foundry, No. 1, f.o.t. ..	115/6
,, No. 3, f.o.t. ..	113/-
Cleveland No. 3, Glasgow	87/-
,, ,, Falkirk ..	84/-
Scottish hem. M/Nos. d/d. .	123/-*

Sheffield (d/d district)—

Derby forge	80/6
,, fdry. No. 3 ..	83/6
Lincs forge	80/6
,, fdry. No. 3 ..	83/6
W.C. hematite	128/6*

Lancashire (d/d eq. Man.)—

Derby fdry. No. 3 ..	89/-
Staffs fdry. No. 3 ..	89/-
Northants fdry. No. 3 ..	87/6
Cleveland fdry. No. 3 ..	89/-
Glengarnock, No. 3 ..	135/-
Clyde, No. 3	135/-
Monkland, No. 3	135/-
Summerlee, No. 3 ..	135/-
Eglinton, No. 3	135/-
Gartsherrie, No. 3 ..	135/-
Shotts, No. 3	135/-

* Subject to a rebate of 5s. per ton under certain conditions.

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)				11	17	6
Nut and bolt iron	10	5	0 to	10	15	0
Hoops				12	15	0
Marked bars (Staffs) f.o.t.				14	7	6
Gas strip				12	15	0
Bolts and nuts, ½ in. × 4 in.				17	10	0 and up.
Steel—						
Plates, ship, etc.	11	8	0 to	11	10	6
Boiler plts.	11	18	0 to	12	0	6
Chequer plts.				13	0	6
Angles				11	0	6
Tees				12	0	6
Joists				11	0	6
Rounds and squares, 3 in. to 5½ in.				12	0	6
Rounds under 3 in. to ½ in. (Untested)				11	9	0
Flats—8 in. wide and over				11	5	6
,, under 8 in. and over 5 in.				11	10	6
Rails, heavy				10	2	6
Fishplates				14	2	6
Hoops (Staffs)				12	4	0
Black sheets, 24g. (4-t. lots)				15	15	0
Galv. cor. shts. (,,)				19	10	0
Galv. flat shts. (,,)				20	0	0
Galv. fencing wire, 8g. plain				17	10	0
Billets, soft, 100-ton lots. .				7	17	6
Sheet bars				7	15	0
Tin bars				7	15	0

PHOSPHOR BRONZE

	Per lb. basis
Strip	$13\frac{1}{2}$d.
Sheet to 10 w.g.	$14\frac{1}{2}$d.
Wire	$15\frac{1}{2}$d.
Rods	$15\frac{1}{2}$d.
Tubes	$20\frac{1}{2}$d.
Castings	16d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising ..	9d. to 1/3
Rolled—	
To 9 in. wide ..	1/3 to 1/9
To 12 in. wide ..	1/3½ to 1/9½
To 15 in. wide ..	1/3½ to 1/9½
To 18 in. wide ..	1/4 to 1/10
To 21 in. wide ..	1/4½ to 1/10½
To 25 in. wide ..	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
to 10g.	1/6½ to 2/1½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/5½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.76
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard ..	95.00
O.-h. rails, h'y, at mill ..	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.15
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb box	$5.35

COKE (at ovens)

Welsh foundry	32/6 to 35/-
,, furnace	27/- to 28/-
Durham foundry	34/6
,, furnace	32/6
Scotland foundry	—
,, furnace	28/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	24/6 to 25/6
,,	28×20 ,,	49/- to 51/-
,,	20×10 ,,	34/6 to 35/6
,,	$18\frac{1}{4}$×14 ,,	24/9 to 25/9
C.W.	20×14 ,,	22/- to 23/-
,,	28×20 ,,	45/- to 46/6
,,	20×10 ,,	31/- to 32/6
,,	$18\frac{1}{4}$×14 ,,	23/- to 25/-

SWEDISH CHARCOAL IRON & STEEL

Pig-iron ..	£12	0	0 to	£13	0	0
Bars-hammered, basis ..	£20	0	0 to	£21	0	0
Bars and nail-rods, rolled, basis ..	£19	0	0 to	£20	0	0
Blooms ..	£16	0	0 to	£17	0	0
Keg steel ..	£27	0	0 to	£30	0	0
Faggot steel	£20	0	0 to	£25	0	0
Bars and rods dead soft st'l	£19	0	0 to	£20	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.		
May	20 ..	62	2	6	dec.	32/6
,,	21 ..	61	5	0	,,	17/6
,,	24 ..	62	0	0	inc.	15/-
,,	25 ..	63	5	0	,,	25/-
,,	26 ..	61	10	0	dec.	35/-

Electrolytic Copper

		£	s.	d.		
May	20 ..	64	0	0	No	change
,,	21 ..	64	0	0	,,	,,
,,	24 ..	64	10	0	inc.	10/-
,,	25 ..	65	0	0	,,	10/-
,,	26 ..	64	10	0	dec.	10/-

Standard Tin (cash)

		£	s.	d.		
May	20 ..	250	5	0	dec.	75/-
,,	21 ..	252	15	0	inc.	50/-
,,	24 ..	253	10	0	,,	15/-
,,	25 ..	253	0	0	dec.	10/-
,,	26 ..	252	0	0	,,	20/-

Tin (English ingots)

		£	s.	d.		
May	20 ..	250	10	0	dec.	80/-
,,	21 ..	253	0	0	inc.	50/-
,,	24 ..	253	15	0	,,	15/-
,,	25 ..	253	0	0	dec.	15/-
,,	26 ..	252	0	0	,,	20/-

Spelter (ordinary)

		£	s.	d.		
May	20 ..	23	2	6	inc.	3/9
,,	21 ..	23	12	6	,,	10/-
,,	24 ..	24	3	9	,,	11/3
,,	25 ..	23	18	9	dec.	5/-
,,	26 ..	23	7	6	,,	11/3

Spelter (Electro, 99.9 per cent.)

		£	s.	d.		
May	20 ..	25	15	0	inc.	2/6
,,	21 ..	26	5	0	,,	10/-
,,	24 ..	26	16	3	,,	11/3
,,	25 ..	26	11	3	dec.	5/-
,,	26 ..	26	0	0	,,	11/3

Lead (soft foreign, prompt)

		£	s.	d.		
May	20 ..	24	5	0	inc.	13/9
,,	21 ..	24	13	9	,,	8/9
,,	24 ..	24	13	9	No	change
,,	25 ..	24	18	9	inc.	5/-
,,	26 ..	24	7	6	dec.	11/3

Lead (English)

		£	s.	d.		
May	20 ..	26	5	0	inc.	15/-
,,	21 ..	26	15	0	,,	10/-
,,	24 ..	26	15	0	No	change
,,	25 ..	26	15	0	,,	,,
,,	26 ..	26	5	0	dec.	10/-

AVERAGE MONTHLY PRICES OF STEEL SHIP PLATES (NORTH OF ENGLAND)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1900	8 0 0	8 0 0	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 0 0	8 0 0	8 0 0	7 10 0	7 0 0	8 0 0
1901	6 15 0	6 15 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 7 6	6 5 0	6 0 0	6 0 0	6 4 4
1902	5 17 6	5 12 6	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 15 0	5 10 0	5 14 7½
1903	5 10 0	5 10 0	5 15 0	6 0 0	6 0 0	6 0 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 10 0	5 13 11
1904	5 7 6	5 10 0	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 12 6	5 11 10
1905	5 15 0	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	5 17 6	6 0 0	6 10 0	7 0 0	7 0 0	6 2 3½
1906	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 10 0	7 0 10½
1907	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 8 4
1908	6 10 0	6 10 0	6 10 0	6 5 0	6 5 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 3 9
1909	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	5 15 0	5 15 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	5 18 9
1910	6 5 0	6 5 0	6 7 6	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 2
1911	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 15 0	6 18 4	6 15 3½
1912	7 3 9	7 5 0	7 5 0	7 12 6	7 15 0	7 15 0	7 15 0	8 0 0	8 0 0	8 0 0	8 2 0	8 5 0	7 14 10
1913	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	7 19 0	7 15 0	7 3 0	6 15 0	6 10 0	7 16 5½
1914	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 0 0	6 0 0	7 0 0	7 5 0	7 5 0	7 6 3	7 10 0	6 14 8½
1915	8 0 0	8 10 0	9 0 0	9 10 0	9 10 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 5 0	11 0 0	9 12 11
1916	11 7 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 9 2
1917	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1918	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0
1919	11 10 0	14 0 0	14 0 0	14 0 0	17 0 0	17 7 6	17 15 0	18 5 0	18 5 0	18 5 0	19 12 6	21 5 0	16 15 5
1920	22 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	23 10 0	24 0 0	24 10 0	24 5 0	24 5 0	23 13 4
1921	23 5 0	22 10 0	20 4 0	19 0 0	19 0 0	17 0 0	15 0 0	14 15 0	13 12 0	12 5 0	10 10 0	10 10 0	16 9 3
1922	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 4 0	10 0 0	9 7 6	9 4 0	9 5 0	9 5 0	9 5 0	9 18 4½
1923	9 7 6	9 15 0	10 5 0	10 10 0	10 10 0	10 10 0	9 18 9	9 17 6	9 17 6	9 17 6	9 18 6	10 6 10½	10 1 2
1924	10 1 6	9 18 1½	9 17 6	9 17 6	9 17 6	9 19 4½	10 5 0	10 5 0	10 5 0	9 19 0	9 15 0	9 15 0	9 19 7½
1925	9 14 0	9 10 0	9 10 0	9 1 3	9 0 0	9 0 0	8 17 0	8 13 1½	8 7 6	8 5 6	7 16 3	7 14 3	8 15 8½
1926	7 12 6	7 12 6	7 12 6	7 14 4½	7 15 0	7 16 10½	8 2 6	8 2 6	8 4 0	8 12 6	8 12 6	8 16 3	8 1 1½
1927	8 17 6	8 17 6	8 11 6	8 7 6	8 6 3	8 5 0	8 5 0	8 3 9	8 2 6	8 2 6	8 5 0	8 5 0	8 7 5
1928	8 2 6	8 5 0	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 6 10½
1929	8 7 6	8 7 6	8 7 6	8 7 6	8 10 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 12 6	8 13 9	8 10 9½
1930	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1931	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1932	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1933	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1934	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1935	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0	8 15 0
1936	8 15 0	8 15 0	8 15 0	8 15 0	8 18 1½	9 7 6	9 7 6	9 7 6	9 7 6	9 7 6	9 7 6	9 7 6	9 2 6½
1937	9 10 6	9 10 6	9 10 6	9 10 6	11 8 0	—	—	—	—	—	—	—	—

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

GENTLEMAN seeks situation as Foundry Manager or Assistant Foundry Manager. Age 38. First class experience from A to Z on steel and iron castings, special alloyed steels and irons, mass production methods, organisation, etc.—Box 386, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Superintendent for North-East Coast. Light castings, pipes, etc. Only those with wide experience of modern methods need apply. State age, experience, and salary required.—Box 398, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

REPRESENTATIVE required to cover Birmingham and Black Country areas, for Fireclays, Refractory and Foundry Materials. Prefer representative already established requiring other agencies.—Box 394, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Patternmaker (wood and metal) for London foundry. Write stating experience and wages expected to: Box 396, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WORKING Foreman wanted for aluminium alloy and non-ferrous castings. Permanency with good prospects for suitable applicant. State experience.—Box 400, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

DIE Casting Shop Manager seeks re-engagement; full control or as Assistant. Has been in charge of aluminium die casting foundry and all subsidiary processes. Well educated, technical training. (295)

YOUNG Foundryman, Technical College trained, Diploma, two First Class City and Guilds Certificates, Bronze Medal, desires situation as Assistant to Foundry Manager. Sound metallurgical, analytical and engineering training. Go anywhere. (296)

METALLURGICAL Chemist requires position in charge, in connection with foundry or other manufacturing organisation. Experience in all special alloys, including aluminium and other non-ferrous alloys. Also fuels, oils, etc. (300)

EXPERIENCED Foundry Foreman requires position. Pump, cylinder and machinery castings; also considerable non-ferrous experience, including aluminium. Up-to-date cupola practice. (301)

FOUNDRY Manager, age 40, requires position. Experience in marine engineering, machine tools and general jobbing foundry. Several years' supervisory experience, capable of taking full charge of important engineering foundry. (302)

PATENT

THE Proprietors of Letters Patent No. 403,768, entitled "Method of Manufacturing Low-Carbon Chromium Alloys," desire to dispose of their patent or to grant licences to interested parties on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development and practical working in this country. Inquiries to be addressed to: CRUIKSHANK & FAIRWEATHER, 65-66, Chancery Lane, London, W.C.2.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1936 edition completely out of print. Next edition 1938. Price 42s. cloth bound. Order your copy now.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & Co., LTD., Station Works, Ecclesfield, Sheffield.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

MOULDING Machines (2) for making cogs in straight or helical. Capacity 15 ft. dia. by 15 in. deep, and 4 ft. dia. by 8 in. deep. Excellent machines. For particulars apply: Box 380, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ELECTRIC CUPOLA BLOWERS (large stock), including two 50-h.p. 3/50/400 volts, 2,900 r.p.m.; Keith Blackman; 12-in. outlet.
30-h.p. ditto; 12-in. outlet.
5-h.p. ditto; 6-in. outlet.
20-h.p. 460 volts d.c., 2,400/1,900 r.p.m.; 10-in. outlet.
EXHAUST FANS (large stock), electrical and belt driven.
ELECTRIC RUNWAY LIFTING BLOCKS:
One 4½-ton 460 volts d.c., Vaughan.
Two 2-ton ditto, Morris.
One ½-ton 220 volts d.c., Morris (as new).
One ½-ton 3/50/440 volts, Aabacas.
Two Reavell Rotary Compressors, 12 lbs. sq. in. pressure; 750 cub. ft. direct-coupled on bedplate to 60 h.p. S.R., 3/50/400 volts motor.
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Geared Foundry Ladles, 9, 4, 3½, 2½ and 1 ton, etc.
AIR COMPRESSORS: 30 in stock in sizes 500 to 20 cub. ft.
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'Phone: Broadwell 1359.

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MACHINERY—*Continued*

'Phone 98 Staines.

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MISCELLANEOUS

WANTED.—Supplier of cast-iron cylindrical rollers for printing machinery, sizes 6 in. to 16 in. diameter, 7 ft. long. Full details to: Goss FOSTER, LIMITED, Preston.

PATTERN MAKING of all descriptions. Specialists in snap-flask timbers.—THE BEDFORD PATTERN MAKING CO., Ampthill Road, Bedford. 'Phone: 2895.

GENUINE Southport Wind Blown Sand, which makes best oil-sand cores. Prompt deliveries by road into works.
JOHN LIVESEY,
SAND MERCHANT,
SOUTHPORT.

'Phone: 287 SLOUGH

30″ dia., Thwaites type Cupola with wind-belt and drop-bottom. Price, **£44.**
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5′ 0″ Rotary Table Sandblast Plant. Price **£150.**
30″ dia., Jackman cupolette on trunnions. Price, **£28.**
5′ 0″ dia. Sand Mill, under geared, as new. Price, **£27.**

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